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OPERABLE UNIT 2 (OU 2) SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN FOR  
NSY PORTSMOUTH ME  
11/01/2004  
TETRA TECH NUS INC

**Operable Unit 2  
Soil Sampling and Treatability Study  
Work Plan**

for

**Portsmouth Naval Shipyard  
Kittery, Maine**



**Engineering Field Activity Northeast  
Naval Facilities Engineering Command**

**Contract Number N62472-03-D-0057**

**Contract Task Order 015**

November 2004

**OPERABLE UNIT 2  
SOIL SAMPLING AND TREATABILITY STUDY  
WORK PLAN**

**PORTSMOUTH NAVAL SHIPYARD  
KITTERY, MAINE**

**COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:  
Environmental Branch (Code EV2)  
Engineering Field Activity Northeast  
Naval Facilities Engineering Command  
10 Industrial Highway, Mail Stop 82  
Lester, Pennsylvania 19113-2090**


**Submitted by:  
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**CONTRACT NUMBER N62472-03-D-0057  
CONTRACT TASK ORDER 015**

**NOVEMBER 2004**

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## **LIST OF ACRONYMS**

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Chemical of Concern
CTO	Contract Task Order
DQI	data quality indicator
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
DVM	Data Validation Manager
EFANE	Engineering Field Activity - Northeast
FOL	Field Operations Leader
FS	Feasibility Study
GCL	geocomposite clay liner
GIS	geographical information system
HASP	Health and Safety Plan
ICP	Inductively Coupled Plasma
IDLs	instrument detection limits
IDW	investigation-derived waste
IRCDQM	Installation Restoration Chemical Data Quality Manual
IRP	Installation Restoration Program
LAN	local area network
LCS	laboratory control sample
MDL	method detection limit
MEDEP	Maine Department of Environmental Protection
MIS	Management Information System
MS	matrix spike
MSD	matrix spike duplicate
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
°C	degree Celsius
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon

PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity/quantitation limits
PCB	polychlorinated biphenyl
pdf	Portable Document Format
PDS	post-digestion spike
PES	performance evaluation sample
PID	Photo Ionization Detector
PM	Project Manager
PNS	Portsmouth Naval Shipyard
PPE	personal protective equipment
PQL	practical quantitation limit
PRG	preliminary remediation goal
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
%R	Percent Recovery
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facilities investigation
RPD	relative percent difference
RPM	Remedial Project Manager
SDG	sample delivery group
SIM	Selective Ion Monitoring
SMC	Sample Management Coordinator
SOP	standard operating procedure
SOW	statements of work
TBD	to be determined
TiNUS	Tetra Tech NUS, Inc
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USEPA-NE	United States Environmental Protection Agency Region I - New England

## **1.0 INTRODUCTION AND PROJECT MANAGEMENT**

This section provides an introduction for the document, explanation of the document format, and a discussion of the project organization.

### **1.1 OBJECTIVE AND SCOPE**

This work plan for the Operable Unit (OU) 2 soil sampling and treatability study at Portsmouth Naval Shipyard (PNS) in Kittery, Maine was prepared for the United States Department of Navy, Engineering Field Activity Northeast (EFANE) by Tetra Tech NUS, Inc. (TtNUS) under the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62472-03-D-0057, Contract Task Order (CTO) 015. The investigation is being conducted as part of the PNS Installation Restoration Program (IRP) and under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

This document provides a discussion of the project management, project background and objectives, sampling and testing requirements and methods, data acquisition and verification requirements and methods, and assessment and oversight activities for soil sample collection and for conducting a treatability study. The soil samples collected in this field investigation will be used to conduct a screening-level, bench-scale soil washing treatability study, also known as a "jar test" (see Guide for Conducting Treatability Studies under CERCLA: Soil Washing, Interim Guidance, EPA/540/2-91/020A, September 1991). This study will be conducted to obtain a reasonable indication of the feasibility of using ex-situ screening and washing to remediate contaminated soil at OU2. The treatability study focuses on Sites 6 and 29 at OU2. The DRMO Impact Area is not included in this plan as, discussed in Section 2.2.

### **1.2 DOCUMENT FORMAT**

This OU2 Soil Sampling and Treatability Study Work Plan was prepared while considering the requirements of the United States Environmental Protection Agency (USEPA) Region 1 New England Quality Assurance Project Plan (USEPA-NE QAPP) guidance (USEPA, October 1999a) as deemed appropriate for the purposes of sample collection for the treatability study. The following provides a discussion of document control procedures and indicates where QAPP elements that are appropriate to the work plan can be found in this document (in USEPA-NE QAPP Worksheet #2 provided at the end of Section 1.0).

Appendix A presents an overview of the distribution of chemicals of concern (COCs) in the soil at OU2. Appendix B contains the Standard Operating Procedures (SOPs) for sample collection and field work. Appendix C contains the work plan for the screening-level soil washing treatability study prepared by ART

Engineering, LLC under subcontract to TtNUS. Appendix D contains the responses to comments on the draft work plan.

### **1.2.1 Document Control**

Document control procedures are used to identify the most current version of the work plan and to help ensure that only the most current version of the work plan is used by all project participants. To meet this goal, text, tables, and figures in the OU2 Soil Sampling and Treatability Study Work Plan include a header indicating the document name, revision number, and date. The footer indicates the page number within the section. Revision 0 with the month and year will be used as part of the header for the draft and final versions. Any revisions made after submittal of the final version will be indicated with the appropriate revision number and date.

A document control numbering system will not be used for the OU2 Soil Sampling and Treatability Study Work Plan because this is a small project with a distinct document distribution list. The work plan and any revisions, addenda, or amendments will be provided in accordance with the PNS distribution list. The PNS distribution list includes USEPA, Maine Department of Environmental Protection (MEDEP), Navy, Natural Resources Trustees, and Restoration Advisory Board (RAB) members. The mailing address and number of copies of the document are provided for each name on the mailing list. In addition, the cover letter accompanying the document includes the distribution list and number of copies (in the case of multiple copies only).

### **1.2.2 USEPA-NE QAPP Worksheet #2**

The USEPA-NE QAPP Worksheet #2 is provided to include prefacing information identifying key project players, previous site work, and the USEPA program for which the current project is being performed. USEPA-NE QAPP Worksheet #2 for the OU2 Soil Sampling and Treatability Study Work Plan is provided at the end of Section 1.0.

## **1.3 DISTRIBUTION LIST AND PROJECT PERSONNEL SIGN-OFF SHEET**

The distribution list for the OU2 Soil Sampling and Treatability Study Work Plan is summarized in Table 1-1. Each person listed in Table 1-1 will receive a copy of this Revision 0 work plan and any subsequent revisions.

Table 1-2 provides an example of the project personnel sign-off sheet, which will be signed by personnel working on the project. A signature on this form indicates the person has read this work plan and is

familiar with the tasks to be performed. The completed sign-off sheet will be maintained in the TtNUS project file.

## **1.4 PROJECT ORGANIZATION**

This section discusses the project organization and personnel responsibilities.

### **1.4.1 Project Organizational Chart**

A Project Organizational Chart depicting the agencies and contracting personnel involved with the OU2 Soil Sampling and Treatability Study Work Plan is included as Figure 1-1. The Navy is the lead agency in addressing this site. TtNUS (Navy contractor) will collect the samples. Katahdin Analytical Services (TtNUS subcontractor) will conduct the laboratory analyses. ART Engineering, LLC (TtNUS subcontractor) will perform the soil washing treatability study. Names and telephone numbers are provided in the Organizational Chart.

### **1.4.2 Communication Pathways**

The following is a summary of the pathways to be used to transfer information and to make alterations to project methods that may be required because of unforeseen circumstances. It will be the responsibility of the TtNUS Project Manager (PM) to keep both the TtNUS project team and the Navy informed of the following:

- Schedule, deliverables, meetings, and milestones
- Recent data collected from the site
- Technical changes made to the plans and specifications
- Developments that will cause changes in the schedule

The TtNUS PM will be in frequent communication with the Navy Remedial Project Manager (RPM). Any changes in the plans and specifications, field methodology, sampling protocol, or data objectives will be communicated to the Navy RPM in a timely manner. As appropriate, a field modification record will be used to identify the need for a change and a recommended course of action. The Navy will consult with USEPA and MEDEP on any major scope changes that may occur while the field work is proceeding.

The TtNUS PM will communicate directly with the field team and indirectly with the subcontractors through the TtNUS Task Manager. The Task Manager will provide technical guidance and assess data as they become available. The laboratory and treatability study subcontractors will notify TtNUS immediately of any issues that develop with the data, quality assurance (QA)/quality control (QC)

requirements, or other problems that may arise during the treatability study. The Navy will be notified if significant issues arise with the laboratory or subcontractors that may affect the data, data quality objectives (DQOs), or schedule.

The TtNUS Field Operations Leader (FOL) will notify the TtNUS PM of the daily sample shipping information and will be in daily contact with the TtNUS PM. The PM will provide sample shipping information to the TtNUS sample shipping coordinator. The FOL and the required subcontractors will communicate directly on site. During site activities, project sample logsheets, logbook notations, and appropriate field forms will be completed in the field and maintained at the TtNUS office.

#### **1.4.2.1 Modifications to the Approved Work Plan**

This section documents the procedures that will be followed when any project activity originally described in the approved work plan requires real-time modification to achieve the project goals.

Proposed changes will be presented to the Navy by TtNUS and followed up with a field modification record for significant changes. The documentation will describe why the change is necessary, the nature of the proposed change, and its impacts on the project. The change will be implemented after Navy concurrence. Minor changes will be documented in the field logbook.

When changes require immediate action, the proposed change will be briefly discussed internally by TtNUS and approved, as appropriate, by the TtNUS PM or Task Manager. The Navy RPM will be notified as soon as possible. Concurrence from USEPA and MEDEP will be sought for any major scope changes, as determined by the Navy. In the event of conditions requiring a major scope change, the investigation will be put on hold until concurrence is obtained.

#### **1.4.3 Personnel Responsibilities and Qualifications**

Mr. John Trepanowski, the Program Manager, is responsible for the overall management and implementation of the Navy CLEAN contract. Ms. Deborah Cohen will serve as the TtNUS PM for the work assignment and has the primary responsibility for the implementation and execution of the work assignment, including technical quality, oversight/review, control of costs and schedule, and implementation of appropriate QA procedures during all phases. Mr. J.P. Kumar will be the TtNUS Task Manager providing oversight for the entire project.

The TtNUS FOL is the primary person who implements the field work activities outlined in this work plan. The FOL will report directly to the TtNUS PM and Task Manager. Responsibilities of the FOL include: supervising TtNUS field staff and field operations, coordinating with the various subcontractors on site,



ensuring the procedures specified in the work plan are properly implemented; identifying and documenting necessary field changes, maintaining daily schedules, and reporting to the PM on a regular basis regarding the status and progress of the field activities. The FOL will also be responsible for ensuring that the field staff adheres to the Health and Safety Plan (HASP), reporting any health and safety issues to the TtNUS Health and Safety Officer, and reporting any hazards, injuries, or decisions to stop work to the TtNUS PM.

The QA Officer will provide input on all aspects of adherence to the work plan to the PM as needed. The lead chemist will be responsible for ensuring that the laboratory supplies the appropriate sample containers to the field, verifying receipt of samples and their integrity at the laboratory, ensuring that the data supplied by the laboratory are complete, and providing liaison with the laboratory contact to obtain data of the content and format that is suitable for the DQOs of this project.

The PNS RAB members are not listed in the organizational chart; however, the Navy will obtain their review and input on this work plan and ensuing reports.

Table 1-3 lists the TtNUS personnel involved in the sampling plan and includes their respective roles, names, and titles. Resumes of the TtNUS personnel are available on request.

#### **1.4.4      Special Training Requirements and Certifications**

Field activity tasks that require special training are summarized in Table 1-4.

USEPA-NE QAPP Worksheet #2 - Rev. 0

**Site Name/Project Name:** OU2 Soil Sampling and  
Treatability Study

**Contractor Name:** Tetra Tech NUS, Inc. (TtNUS)

**Contract Task Order Number:** 015

**Contract Title:** Navy Comprehensive Long-Term  
Environmental Action Navy (CLEAN) Program

**Site Location:** Portsmouth Naval Shipyard, Kittery, Maine

**Site Number/Code:** Sites 6 and 29

**Operable Unit:** Operable Unit 2

**1. Identify Guidance used to prepare QAPP:**

**Region I, USEPA-NE Compendium QAPP Guidance, Attachment** and/or other:

**Region 1 USEPA-New England Compendium of Quality Assurance Project Plan Guidance, October 1999a, Final.**

**2. Identify USEPA Program:** Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

**3. Identify approval entity: USEPA-NE or State:** USEPA-NE  
or other entity: \_\_\_\_\_

**4. Indicate whether the QAPP is a generic program QAPP or a project specific QAPP:**  
Project Specific

**5. List dates scoping meetings were held:** Navy team scoping and planning activities were conducted through electronic mail, teleconference, and meetings as discussed in Section 2.0.

**6. List dates and titles of QAPP documents written for previous site work, if applicable:**

**7. List organizational partners (stakeholders) and connection with USEPA and/or State:**

MEDEP

Natural Resources Trustees

PNS RAB

**8. List data users:** The Navy will use the data to get an early indication of whether soil washing can be used as a remedy at OU2. The USEPA, MEDEP, and PNS RAB will review the work plan. A treatability study report will be prepared based on the data to be collected and based on other data to be generated during the soil washing process.

**9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable to the project, then circle the omitted QAPP Elements, Worksheets, and Required Information on the attached Table. Provide an explanation for their exclusion below:**

The information needed for the worksheets were directly filled into the tables of relevant sections; therefore, except for this worksheet (Worksheet #2), worksheets are not included in the work plan.

REQUIRED USEPA QA/R-5 ELEMENTS	WORK PLAN SECTION	RELEVANT USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
<b>Project Management and Objectives</b>				
A1	Begin. of Document	1.0 Title and Approval Page	1	- Title and Approval Page
A2	1.2 Begin. of Document 1.2.1 1.2.1 1.2.2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 USEPA-NE QAPP Worksheet #2	2	- Table of Contents - USEPA-NE QAPP Worksheet
A3	1.3	3.0 Distribution List and Project Personnel Sign-off Sheet	3 4	- Distribution List - Project Personnel Sign-off Sheet
A4, A8	1.4 1.4.1 1.4.2 1.4.2.1 1.4.3 1.4.4	4.0 Project Organization 4.1 Project Organizational Chart 4.2 Communication Pathways 4.2.1 Modifications to Approved QAPP 4.3 Personnel Responsibilities and Qualifications 4.4 Special Training Requirements/ Certification	5a 5b 6 7	- Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table
A5	2.1 2.1.1 2.1.2, 2.1.3, 2.1.4	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a 8b	- Project Planning Meeting Documentation - Project Scoping Meeting Attendance Sheet with Agenda - Problem Definition/Site History and Background - USEPA-NE DQO Summary Form - Site Maps (historical and present)

REQUIRED USEPA QAR-5 ELEMENTS	WORK PLAN SECTION	RELEVANT USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
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**Project Management and Objectives (Continued)**

A6	2.2	6.0 Project Description and Schedule	9a	- Project Description
	2.2.1 through 2.2.9	6.1 Project Overview	9b	- Contaminants of Concern and Other Target Analytes Table
	2.2.10	6.2 Project Schedule	9c	- Field and Quality Control Sample Summary Table
			9d	- Analytical Services Table
			10	- System Designs - Project Schedule Timeline Table
A7	2.3	7.0 Project Quality Objectives and Measurement Performance Criteria	11a	- Measurement Performance Criteria
	2.3.1	7.1 Project Quality Objectives	11b	
	6.0	7.2 Measurement Performance Criteria		

**Measurement/Data Acquisition**

B1	3.1	8.0 Sampling (Field) Process Design	12a	- Sampling (Field Investigation) Rationale
	3.1.1 through 3.1.6	8.1 Sampling Design Rationale	12b	- Sampling Locations, Sampling and Analytical Method/SOP Requirements Table - Sample Location Map
B2, B6, B7, B8	3.2	9.0 Sampling Procedures and Requirements	13	- Sampling SOPs
	3.2.1 through 3.2.6	9.1 Sampling Procedures	12b	- Project Sampling SOP Reference Table
	3.2.6	9.2 Sampling SOP Modifications	14	- Sampling Container, Volumes and Preservation Table
	3.3.2	9.3 Cleaning and Decontamination of Equipment/Sample Containers	15	- Field Sampling Equipment Calibration Table - Cleaning and Decontamination SOPs
	NA	9.4 Field Equipment Calibration		- Field Equipment Maintenance, Testing and Inspection Table
	NA	9.5 Field Equipment Maintenance, Testing and Inspection Requirements		
	NA	9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers		

REQUIRED USEPA QA/R-5 ELEMENTS	WORK PLAN SECTION	RELEVANT USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
<b>Measurement/Data Acquisition (Continued)</b>				
B3	3.3	10.0 Sample Handling, Tracking, and Custody Requirements	16	<ul style="list-style-type: none"> <li>- Sample Handling, Tracking and Custody SOPs</li> <li>- Sample Handling Flow Diagram</li> <li>- Sample Container Label (Sample Tag)</li> <li>- Chain-of-Custody Form and Seal</li> </ul>
	4.1	10.1 Sample Collection Documentation		
		10.1.1 Field Notes		
		10.1.2 Field Documentation Management System		
	4.3	10.2 Sample Handling and Tracking System		
	4.2	10.3 Sample Custody		
B4, B6, B7, B8	NA	11.0 Field Analytical Method Requirements	17	<ul style="list-style-type: none"> <li>- Field Analytical Methods/SOPs</li> <li>- Field Analytical Method/SOP Reference Table</li> <li>- Field Analytical Instrument Calibration Table</li> <li>- Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Table</li> </ul>
	NA	11.1 Field Analytical Methods and SOPs		
	NA	11.2 Field Analytical Method/ SOP Modifications		
	NA	11.3 Field Analytical Instrument Calibration		
	NA	11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements		
	NA	11.5 Field Analytical Inspection and Acceptance Requirements for Supplies		

REQUIRED USEPA QA/R-5 ELEMENTS	WORK PLAN SECTION	RELEVANT USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
<b>Measurement/Data Acquisition (Continued)</b>				
B4, B6, B7, B8	4.2	12.0 Fixed Laboratory Analytical Method Requirements	20	<ul style="list-style-type: none"> <li>- Fixed Laboratory Analytical Methods/SOPs</li> <li>- Fixed Laboratory Analytical Method/SOP Reference Table</li> <li>- Fixed Laboratory Instrument Maintenance and Calibration Table</li> </ul>
	4.2.1	12.1 Fixed Laboratory Analytical Methods and SOPs	21	
	4.2.2	12.2 Fixed Laboratory Analytical Method/SOP Modifications		
	4.2.3	12.3 Fixed Laboratory Instrument Calibration		
	4.2.4	12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements		
	4.2.5	12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies		
B5	4.3	13.0 Quality Control Requirements	22a	<b>Sampling</b> <ul style="list-style-type: none"> <li>- Field Sampling QC Table</li> <li>- Field Sampling QC Table cont.</li> </ul> <b>Analytical</b> <ul style="list-style-type: none"> <li>- Field Analytical QC Sample Table</li> <li>- Field Analytical QC Sample Table cont.</li> <li>- Field Screening/Confirmatory Analysis Decision Tree</li> <li>- Fixed Laboratory Analytical QC Sample Table</li> <li>- Fixed Laboratory Analytical QC Sample Table cont.</li> </ul>
	4.3.1	13.1 Sampling Quality Control	22b	
	4.3.2	13.2 Analytical Fixed Laboratory Quality Control	23a	
			23b	
		13.2.1 Field Analytical QC	24a	
		13.2.2 Fixed Laboratory QC	24b	
B9	5.1	14.0 Data Acquisition Requirements	25	- Non-Direct Measurements Criteria and Limitations Table

REQUIRED USEPA QA/R-5 ELEMENTS	WORK PLAN SECTION	RELEVANT USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
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**Measurement/Data Acquisition (Continued)**

A9, B10	5.2	15.0 Documentation, Records, and Data Management	26	<ul style="list-style-type: none"> <li>- Project Documentation and Records Table</li> <li>- Data Management SOPs</li> </ul>
	5.2.1	15.1 Project Documentation and Records		
	5.2.2	15.2 Field Analysis (Testing) Data Package Deliverables		
	5.2.3	15.3 Fixed Laboratory Data Package Deliverables		
	5.2.4	15.4 Data Reporting Formats		
	5.2.5	15.5 Data Handling and Management		
	5.2.6	15.6 Data Tracking and Control		

**Assessment/Oversight**

C1	7.1	16.0 Assessments and Response Actions	27a 27b 27c	<ul style="list-style-type: none"> <li>- Assessment and Response Actions</li> <li>- Project Assessment Table</li> <li>- Project Assessment Plan</li> <li>- Audit Checklists</li> </ul>
	7.1.1	16.1 Planned Assessments		
	7.1.2	16.2 Assessment Findings and Corrective Action Responses		
		16.3 Additional QAPP Non-Conformances		
C2	7.2	17.0 QA Management Reports	28	<ul style="list-style-type: none"> <li>- QA Management Reports Table</li> </ul>

**Data Validation and Usability**

D1	6.1	18.0 Verification and Validation Requirements		<ul style="list-style-type: none"> <li>- Validation Criteria Documents</li> </ul>
D2	6.2	19.0 Verification and Validation Procedures	29a	<ul style="list-style-type: none"> <li>- Data Evaluation Process</li> <li>- Data Validation Summary Table</li> <li>- Data Validation Modifications</li> </ul>
			29b	
			29c	
D3	6.3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	<ul style="list-style-type: none"> <li>- Data Usability Assessment</li> </ul>

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**TABLE 1-1**  
**DISTRIBUTION LIST**  
**OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

<b>QAPP Recipients</b>	<b>Title</b>	<b>Organization</b>	<b>Telephone Number</b>
Ms. Matthew Audet	USEPA RPM	USEPA Region 1	617-918-1449
Mr. Iver McLeod	MEDEP RPM	MEDEP	207-287-8010
Mr. Fred Evans	Navy RPM	EFANE, Navy	610-595-0567 ext. 159
Ms. Marty Raymond	PNS IRP Manager	PNS, Kittery, Maine	207-438-2536
Ms. Deborah Cohen	TtNUS PM	TtNUS, Pittsburgh, PA	Contact Mr. Fred Evans
Ms. Kelly Carper	TtNUS QA Officer	TtNUS, Pittsburgh, PA	Contact Mr. Fred Evans
Mr. J.P. Kumar	TtNUS Task Manager	TtNUS, Pittsburgh, PA	Contact Mr. Fred Evans
Ms. Kayleen Jalkut	TtNUS Geologist	TtNUS, Wilmington, MA	Contact Mr. Fred Evans
Andrea Colby	Analytical Laboratory Subcontractor	Katahdin Analytical Services	Contact Mr. Fred Evans
Carl Seward	Treatability Study Subcontractor	ART Engineering, LLC.	Contact Mr. Fred Evans

Note: All members on the PNS distribution list (including RAB members) will receive copies of the QAPP and all updates to the QAPP. A complete distribution list is available from the Navy and can be readily provided on request. The TtNUS PM will be responsible for distribution of copies of the QAPP and all updates to the QAPP to TtNUS project personnel including the TtNUS FOL.

TABLE 1-2  
EXAMPLE PROJECT PERSONNEL SIGN-OFF SHEET  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Project Personnel	Title	Signature	Date QAPP Read	QAPP Acceptable As Written
Deborah Cohen	TtNUS PM			
Kelly Carper	TtNUS QA Officer			
J.P. Kumar	TtNUS Task Manager			
Kayleen Jalkut	TtNUS Geologist			
Joseph Samchuk	Data Validation Supervisor			

TABLE 1-3

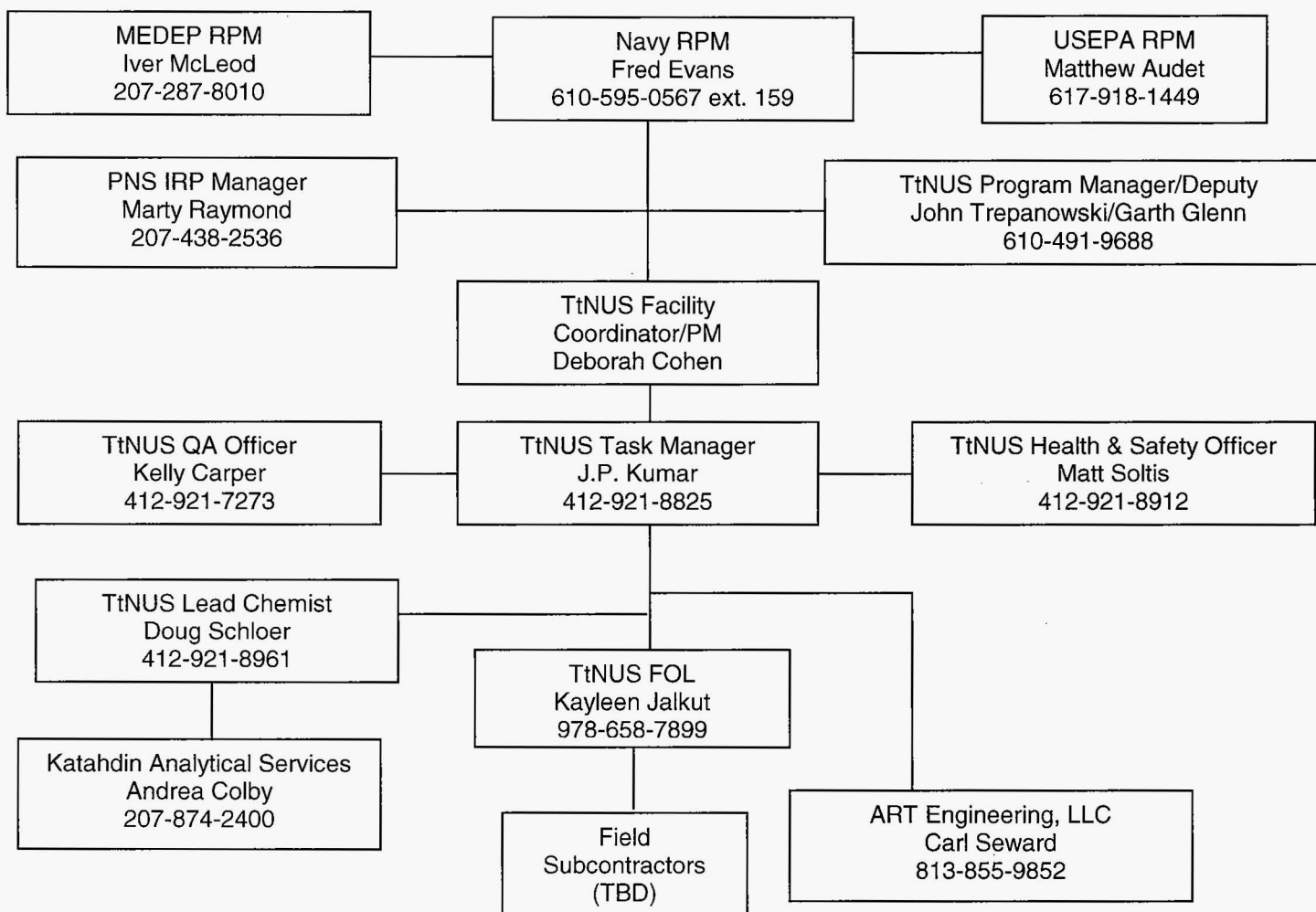
**PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

<b>Name</b>	<b>Organizational Affiliation</b>	<b>Responsibilities</b>	<b>Location of Personnel Resumes, if not included</b>	<b>Education and Experience Qualifications</b>
John Trepanowski/ Garth Glenn	TtNUS	Program Manager/Deputy	TtNUS, King of Prussia, PA	Available on request
Deborah Cohen	TtNUS	PM	TtNUS, Pittsburgh, PA	Available on request
Kelly Carper	TtNUS	QA Officer	TtNUS, Pittsburgh, PA	Available on request
Matt Soltis	TtNUS	Health and Safety Officer	TtNUS, Pittsburgh, PA	Available on request
J.P. Kumar	TtNUS	Task Manager	TtNUS, Pittsburgh, PA	Available on request
Kayleen Jalkut	TtNUS	Geologist	TtNUS, Wilmington, MA	Available on request
Doug Schloer	TtNUS	Lead Chemist	TtNUS, Pittsburgh, PA	Available on request

**TABLE 1-4**  
**SPECIAL PERSONNEL TRAINING REQUIREMENTS**  
**OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Project Function	Specialized Training Title of Course or Description	Training Provided By	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Sampling	<ul style="list-style-type: none"> <li>40-hour Occupational Safety and Health Administrative training, 8 hour annual refresher training</li> <li>Supervisory training</li> </ul>	Health and safety training specialists	Various	<ul style="list-style-type: none"> <li>All field (onsite) personnel</li> <li>FOL</li> </ul>	FOL and field sampling team members	<p>Training records for TtNUS employees are maintained by TtNUS.</p> <p>Training records will be obtained from all subcontractor personnel as appropriate.</p>

**FIGURE 1-1**  
**PROJECT ORGANIZATIONAL CHART**  
**OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**



\* All contact with TtNUS personnel and subcontractors by nonfield personnel should be made through Mr. Fred Evans.

## 2.0 PROJECT OBJECTIVES

This section discusses the project objectives. To maintain consistency with the USEPA-NE QAPP guidance (USEPA, October 1999a), the outputs of the first DQO step (problem definition) are summarized in work plan Section 2.1, and the outputs of remaining steps are summarized in Section 2.2. As necessary, more detailed information is provided in Section 2.3.

### 2.1 PROJECT PLANNING / PROJECT DEFINITION

This section documents project planning, provides the site background, and identifies the basis for the investigation (project definition).

#### 2.1.1 Project Planning

Project planning/scoping was conducted during August/September 2004 by the EFANE, Lester, Pennsylvania; and TtNUS Pittsburgh, Pennsylvania. The planning and scoping were conducted via electronic mail to develop and document the DQOs for this project and were supplemented by input via telephone. Regulatory and RAB participation in project planning is through review and comment on the draft work plan.

This project is being performed under CERCLA. The project DQOs were developed in accordance with the USEPA Guidance for the DQO Process, commonly known as QA/G-4 (USEPA, August 2000). The emphasis for this work plan is on the non-statistical aspects of DQO planning (DQO Steps 1 through 5), with a discussion of the rationale for numbers and locations of samples.

The USEPA Region I QAPP Manual (USEPA, October 1999a) provides worksheets to be completed during DQO planning meetings. The QAPP tables corresponding to the applicable worksheets were developed directly for insertion into the work plan to expedite its preparation.

#### 2.1.2 Facility Location and Description

PNS is a military facility with restricted access located on an island in the Piscataqua River, as shown on Figure 2-1. PNS is referred to on National Oceanic and Atmospheric Administration (NOAA) nautical charts as Seavey Island, with the eastern tip given the name Jamaica Island. Attached to Seavey Island by a rock causeway is Clark's Island. The Piscataqua River is a tidal estuary that forms the southern boundary between Maine and New Hampshire. PNS is located in Kittery, Maine, north of Portsmouth, New Hampshire, at the mouth of the Great Bay Estuary (commonly referred to as Portsmouth Harbor).

PNS is engaged in the conversion, overhaul, and repair of submarines for the Navy. The long history of shipbuilding in Portsmouth Harbor dates back to 1690, when the first warship launched in North America, the Falkland, was built. PNS was established as a government facility in 1800, and it served as a repair and building facility for ships during the Civil War. The first government-built submarine was designed and constructed at PNS during World War I. A large number of submarines have been designed, constructed, and repaired at this facility since 1917. PNS continues to service submarines as its primary military focus.

### **2.1.3 OU2 Description and History**

OU2 consists of Site 6 (Defense Reutilization and Marketing Office Storage Yard or DRMO) and Site 29 (former Teepee Incinerator Site). The DRMO Impact Area, in which Quarters S, N, and 68 are located, is also included in OU2 because this area was thought to be impacted by particulate deposition from the DRMO. OU2 is located in the south-central portion of PNS as shown on Figure 2-1. Figure 2-2 shows the locations of Sites 6, 29, and the DRMO Impact Area.

#### **Site 6 - DRMO**

The DRMO was established in 1920. This area was originally known as Henderson's Point, named after a portion of land that protruded 350 feet into the Piscataqua River. The point was excavated in 1905 to widen the channel. The excavated fill was deposited along the shore of the Shipyard, adjacent to Henderson's Point including the area encompassed by Sites 6 and 29.

Site 6 is approximately 2 acres in area, and has served multiple purposes from a stone crusher facility to its current use as a temporary storage area since approximately 1960. Most of the site is situated on filled land. Previous visual inspection indicated ponding of precipitation in some areas and direct runoff to the Piscataqua river in other areas. The practices, such as open storage of batteries, which could cause contaminants to be leached or otherwise released by pathways such as infiltration or runoff, were terminated approximately in 1983.

In 1993, interim corrective measures at Site 6 included the capping and paving of sections of the site, installation of storm water controls, and installation of a new concrete curb. The cap consists of 12 inches of compacted, crushed stone aggregate stabilized with Portland cement, two layers of 16-ounce, non-woven, needled-punched geotextile, and a geocomposite clay liner (GCL). An area on the northwestern side of Site 6 was paved with 2 inches of asphalt. Details of the interim corrective measures are presented in the Interim Corrective Measures at the DRMO report (McLaren/Hart, April 1993).

Periodic shoreline inspections were conducted at OU2. In the summer of 1999, erosion was discovered along the shoreline of the Piscataqua River adjacent to Site 6. The existing embankment rock had sloughed, exposing lead-contaminated soil from the site and so in July 1999, eight surface soil samples of the eroding soil were collected. In September 1999, the exposed soil was covered with hydromulch as an interim erosion control measure until the slope stabilization could be conducted. An emergency removal action under CERCLA was implemented to protect human health and the environment from a release of lead contamination. Keel blocks and other materials from the shoreline slope were removed, and the bank was regraded with existing rock. Pea gravel was placed over existing soil as necessary to provide a level surface, and a geotextile layer was placed over the gravel. The geotextile was covered with a layer of coarser stone then a layer of armor stone for wave action protection. A curb and fence were also installed (FWENC, June 2001).

Most of the site is situated on filled land and is covered by asphalt or a clay/concrete cap. Fill material encountered during soil borings and monitoring well installations was noted as large angular rock fragments (from the blasting of Henderson's Point), scrap metal, wood debris, sand and gravel, and sandblasting grit. Groundwater is influenced by tidal fluctuations of the Piscataqua River.

#### **Site 29 - Teepee Incinerator Site**

The area described as the Teepee Incinerator was at one time part of the DRMO (Site 6). The site encompasses the area surrounding a former open burning area, a former industrial incinerator (Teepee Incinerator), and an ash disposal area. The first reported activity at Site 29 began in 1918 with open burning of Shipyard refuse. The open burning area was reportedly used to burn Shipyard solid waste and as a dumping area for residual waste (i.e., paper, wood, and rubbish). Open burning continued at Site 29 until the construction of the Teepee Incinerator at the site in 1965. Approximately 75,000 cubic yards of refuse were burned annually in open fires prior to construction of the incinerator (TtNUS, March 2000).

The incinerator included a teepee-type steel frame with a metal-covered refuse burner, a top catwalk, access ladder, steel inner liner, entrance and clean-out doors, forced draft blowers and piping, stainless-steel fire screen and foundation, and bucket slip rails. It was located near the boundary of fill and natural material in the vicinity of Building 314 as shown on Figure 2-2. It had a diameter of approximately 67.5 feet and a height of approximately 72.5 feet. The Teepee Incinerator was used primarily for disposal of wood, paper, and rubbish with occasional burning of cans of paint and solvents. Reportedly, in 1971, approximately 1,150 cubic yards of combustible waste were burned a week at the incinerator. Ash from the incinerator was deposited south of the incinerator until 1971 when the residue began to be landfilled in the Jamaica Island Landfill (Site 8) and the Kittery municipal landfill. The incinerator ceased operations in 1975 (TtNUS, March 2000).



Site 29 includes the area surrounding Buildings 310, 314, and 298 along the southern shoreline of PNS, as illustrated on Figure 2-2. The site slopes gently south to the Piscataqua River from the base of a steep bedrock outcrop that has approximately 20 to 30 feet of relief to the north and east of the site. Two buildings, 310 and 314, were located on the site. The former pesticide handling building (Building 314) was a modern facility constructed in 1982 and operated by two State of Maine certified pest control personnel. Operations ceased at Building 314 in March 1995 when pesticide control services were contracted out by the Shipyard. Between 1982 and March 1995, Building 314 was used to store small quantities of pesticides prior to mixing for use at the Shipyard. Any expired or unusable pesticides and herbicides were disposed of through the Shipyard's hazardous waste facility. No waste was stored in this building. There were no floor drains within the building; however, there was a lavatory within the building that was connected to the sanitary sewer. There was also a catch basin equipped with a "flap valve", located in the apron outside the building to the garage that was used as a containment basin in the event there was a spill. There is no record of any spills at or near Building 314. The building was demolished in December 1998. The area around the buildings is grassy, and asphalt pavement exists from Buildings 310 and 314 and Building 298, west of the site (TtNUS, March 2000).

#### **DRMO Impact Area – Quarters S, N, and 68**

The DRMO Impact Area is an area north of Site 6 that was identified in the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) as potentially being impacted by wind dispersal of contaminants from the DRMO (McLaren/Hart, July 1992). The area is a residential area for military personnel and includes Quarters S, N, and 68. Risk assessment indicated that unacceptable human health risks do not exist at the DRMO Impact Area (TtNUS, November 2000).

#### **2.1.4 Problem Definition**

Based on the risk assessment for OU2 (TtNUS, November 2000), chemical concentrations in the soil at Sites 6 and 29 are at concentrations that may pose a potential risk for people at the site. The DRMO Impact Area soils did not have site-related chemical concentrations that may pose potential risks for people. The site-related COCs identified for Sites 6 and/or 29 are lead, antimony, Aroclor-1254, benzo(a)pyrene, and dioxins/furans. A Feasibility Study (FS) is being prepared for OU2 to identify and evaluate potential remedial options for soil remediation, including treatment of soil using ex-situ soil washing. Soil washing (with particle-size based separation using dry and water-based wet screening, and density-based separation) may be appropriate for the COCs at Sites 6 and 29 depending on the physical conditions of the soil. Therefore, the Navy will conduct a screening-level, bench-scale treatability study to provide a reasonable indication of the feasibility of soil washing as remedial option for OU2.

Large volume soil samples will be used in the treatability study to determine whether the treatment is feasible. These soil samples need to be representative of the contaminants and physical characteristics of the surface and subsurface material, at Sites 6 and 29. Therefore, sampling locations need to be identified that are considered representative to support the treatability study.

### **Problem Statement**

A screening-level treatability study needs to be conducted to provide an indication of the potential feasibility of the technology in treating the soil COCs. A semi-quantitative evaluation of the potential effectiveness of the technology for the removal of COCs and for the recovery of clean soil mass is needed to provide an indication of whether more detailed testing is warranted. Bulk soil samples collected for the treatability study need to reflect the chemical and physical characteristics of the site.

## **2.2 PROJECT DESCRIPTION AND SCHEDULE**

This section of the work plan provides a general overview of the activities that will be performed as part of the soil sampling tasks and how and when they will be performed to address the problem defined in Section 2.1. Specific details for individual project activities are discussed in later sections of the work plan, as indicated herein. The specific treatability study activities are discussed in Appendix C.

### **2.2.1 Project Overview**

The project planning phase determines the project quality objectives, i.e., the type, quantity, and quality of information needed to ensure project data can be used for their intended purposes. The project planning considerations are discussed in Section 2.1. The project quality objectives are discussed in Section 2.3.

During project planning, the site contaminants, sampling tasks, systems design, analytical tasks, data verification and validation tasks, QA assessment, data usability assessments, and the generation of records and reports are considered to determine how and when investigation activities will be conducted. The following discusses how the project planning items were considered for the OU2 soil sampling activity.

### **2.2.2 Soil Washing Treatability Study**

At OU2, a remedy screening level soil washing treatability study will be conducted to obtain an indication of the potential effectiveness of the technology for the removal of contaminants present in the soil. This level of testing provides an early indication of whether the technology is suitable for a more detailed phase of testing to meet cleanup goals for the site.

Soil washing is technology that may include any combination of technologies including (but not limited to) soil particle size-based separation, density separation, attrition scrubbing, flotation, and surfactant washing. In some cases, (mild) chemical extraction using acids, alkalis, and complexing agents may be used. Because each project varies in the soil type, and contamination type, the soil washing process configuration is based on site-specific requirements and cost-effectiveness. Therefore, a treatability study is typically required to evaluate the effectiveness of the technology at a particular site.

Soil washing typically incorporates particle size separation during washing. Particle size separation is usually an effective treatment step because many organic and inorganic contaminants have a tendency to bind to clay, silt, and organic soil particles. Washing separates fine clay and silt particles from the coarser sand and gravel soil particles, effectively separating and concentrating the contaminants into a smaller volume consisting of the clay and silt fraction. Density-based separation may also be employed during soil washing, especially if the potential for removal of heavier particles such as lead fragments (as opposed to lead compounds adhered to soil particles) may exist. Froth flotation may be employed during a full-scale soil washing process if lighter particles containing polycyclic aromatic hydrocarbon (PAH), polychlorinated biphenyl (PCBs), or dioxin may be present in the soil.

Considering various factors related to the OU2 site data and history, and ART Engineering, LLC's experience, the following processes are proposed for this screening level evaluation of a potential soil washing process that may be employed at the site:

- Particle-size based separation
- Density-based separation

The results of the density-based separation will provide an indication of the potential effectiveness of the removal of heavier as well as lighter particles.

### **2.2.3      Field Investigation Activities**

Test pitting will be conducted as part of soil sampling for the treatability study. Test pitting will be used to expose a sufficient portion of the subsurface at selected locations to obtain samples of soil and other associated material potentially containing COCs for the treatability study testing. Soil samples from test pitting will reflect the physical and chemical characteristics of material that will be excavated during an actual remediation. Therefore, the soil washing treatability study will be conducted on materials that are expected to be similar to those expected to be encountered during a treatment process of a full-scale remediation system.

Details of the rationale for sample locations are discussed in Section 3.1. Details of the investigation procedures are discussed in Sections 3.2 and 3.3. The sections following Section 3.0 describe how the fixed-base laboratory data will be verified, checked for quality, processed, and presented in a report.

#### **2.2.4      Systems Designs**

This section (in the QAPP Manual, USEPA, October 1999) relates to remediation and/or monitoring engineering design systems. Such systems are not applicable to the treatability study-related activities and therefore systems designs are not discussed further.

#### **2.2.5      Analytical Tasks**

Test pit samples need to be analyzed at a minimum for the following risk-driving COCs identified in the OU2 risk assessment (TtNUS, November 2000): lead, antimony, Aroclor-1254, benzo(a)pyrene, and 2,3,7,8-TCDD. Other Aroclors and PAHs may be included in the analyses for additional information. Section 5.0 discusses the fixed-based laboratory analytical requirements.

#### **2.2.6      Data Verification and Validation Tasks**

Fixed-base laboratory data will undergo verification and limited validation as described in Section 6.2.

#### **2.2.7      Data Usability Assessments**

Data usability assessments will be based on the results of data verification and checking and a reconciliation of the investigation outcome with project quality objectives. Descriptions of these activities are provided in Section 6.3. Data usability will also be evaluated during the treatability study.

#### **2.2.8      Quality Assurance Assessments**

QA assessment for this project is discussed in Section 6.0 of this work plan.

#### **2.2.9      Records and Reports**

This work plan was submitted for review to the USEPA, MEDEP, and RAB as a draft version. The final version was prepared in response to the comments received on the draft version and documented herein as Appendix D. The final version will be distributed per the PNS distribution list (see Table 1-1).

The data collected from the analysis of the test pit samples will be reported in the treatability study report. The treatability study report will contain the following field and fixed-base laboratory documentation:

- Results of the initial characterization of test pit samples
- Methodology and results of the soil washing treatability study
- Other supporting documentation including:
  - Soil sample collection logs and records
  - Test pitting logs
  - Chain-of-custody forms
  - Data validation results
  - Treatability study test data and photographs

Deviations from the final work plan will also be discussed in the treatability study report.

#### **2.2.10 Project Schedule**

The schedule for the main phases of the project and deliverables is presented in Table 2-1.

### **2.3 PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERIA**

This section details the project quality objectives developed for the soil sampling task to support the treatability study. According to the USEPA-NE QAPP guidance (USEPA, October 1999), project quality objectives are descriptions of the type, quality, and quantity of data needed to answer a specific environmental question. Similar criteria have been adapted for use in determining the requirements of the treatability study. Measurement performance criteria are objective measures that can be used to determine whether a project quality objective has been met.

#### **2.3.1 Project Quality Objectives**

Project quality objectives were developed using the USEPA DQO process as a guide. The seven DQO steps are as follows:

1. State the objectives
2. State the decisions to be made
3. Identify information needed to make the decisions
4. Establish spatial and temporal boundaries of investigation
5. State the decision rules

6. Establish error tolerances
7. Optimize the field investigation

A summary of each of these steps, as they apply to the soil sampling and the treatability study described in this work plan, is provided below. Details on the sampling process design and sampling procedures/requirements for the field work are provided in Section 3.0.

### **Step 1 - State the objective**

The problem definition is discussed in Section 2.1.4. Based on the problem definition, the objective is to evaluate the potential effectiveness of soil washing for removal of COCs from the soil and recovery of clean soil mass at OU2.

### **Step 2 - State the decisions to be made**

The decisions to be made are as follows:

- Determine whether risk-driving COCs are present in the soil samples collected during the initial phase of the soil washing treatability study and select appropriate samples for continuation of testing.
- Determine whether soil washing is effective in reducing COC concentrations and recovery of clean soil mass.

The results of the treatability study will be made available to the USEPA, MEDEP, and RAB. The information will be used in the evaluation and selection of the appropriate remedial option for OU2.

### **Step 3 - Identify information needed to make decision**

The information needed to make the decision is as follows:

- Visual descriptions of the physical characteristics of subsurface material. The subsurface material encountered during test pitting is expected to be similar to material that would be excavated from the site during remediation. Therefore, samples will be collected from test pits excavated from the site, and visual descriptions of soil will be recorded on test pit logs.
- Chemical data from the analysis of test pit samples. The test pit samples will be composite samples collected to represent the heterogeneous nature of the subsurface material at the site. The data from

the test pit samples will consist of the results from the analyses for lead, antimony, benzo(a)pyrene, Aroclor-1254, and 2,3,7,8-TCDD.

- Chemical data from the analysis of various fractions of materials (soil, debris, etc.) generated from the soil washing process. Data from the analyses of primary COCs (lead and benzo(a)pyrene) will be used as chemical indicators of the effectiveness of various stages of the soil washing study. Data from the analyses of a complete list of COCs (lead, benzo(a)pyrene, Aroclor-1254, and 2,3,7,8-TCDD) will be used as chemical indicators of the overall effectiveness of the soil washing study.
- Physical data (particle size distribution, mass, and moisture content) of various fractions generated from the soil washing process will be used for evaluation of the clean soil mass recovery.

#### **Step 4 - Establish spatial and temporal boundaries of investigation**

The spatial and temporal considerations for the decisions identified in Step 2 are identified in Step 4. These considerations for the sample collection and treatability study work are as follows:

- Test pits are located where contamination has previously been detected. The depth of the test pits will be limited to 10 feet below ground surface (bgs) or the depth to groundwater, whichever is shallower. This is the maximum depth to which excavation and treatment using soil washing would be considered for human health exposure.
- The temporal boundaries are not critical to the sample collection activity, although attempts should be made to excavate the test pits around the time of low tide in the Piscataqua River. This temporal guidance is given to ensure that the excavation is not terminated prematurely. The expected depths to groundwater during low tide and high tide at various locations of the site should be used as a guide during the excavation.
- A temporal boundary associated with the soil washing study is the selection of samples for continuation of testing following the initial characterization.

#### **Step 5 - State the decision rules**

During the initial characterization phase of the treatability study, if it is determined that risk-driving COCs are present at elevated levels in the test pit samples, then the treatability study work will proceed. Otherwise, decisions will be made based on the soil sample results regarding the need to collect additional samples or to terminate further work on the treatability study.

If concentrations of risk-driving COCs present in the untreated soil are reduced sufficiently by the soil washing process, and a sufficient fraction of clean soil is recovered, then further evaluation of the technology will be recommended. Otherwise, no further evaluation of the technology will be recommended. Details of the decision rules are provided in Section 2.3.2.

#### **Step 6 - Establish error tolerances**

Error tolerances are not applicable to the selection of samples, which are targeted for biased locations. Error tolerances are not applicable to the remedy-screening stage of the treatability study because concentration reductions are expected to be greater than the uncertainties in measuring the contaminant concentrations.

#### **Step 7 - Optimize the field investigation plan**

Available data on the site have been used to determine the number and locations of test pits using the rationale provided in Section 3.0. Optimization of the field investigation includes the collection of samples from two additional test pits to serve as supplements or replacements for three test pits as discussed in Section 3.0. This procedure will reduce the potential for remobilization and additional test pit excavation and sampling. Field activities are discussed in detail in Section 3.0.

### **2.3.2 Details of Decision Rules**

The outputs from DQO Steps 1 through 4 are assimilated into descriptions of how data will be used for decision making. The risk-driving COC concentrations in the test pit samples collected during the initial phase of characterization will be used to make decisions for conducting the treatability study as discussed below. The concentrations of COCs in various fractions of soil and debris, and masses of these fractions generated during soil washing will be used to estimate the removal efficiencies, and accordingly recommendations regarding the potential use of the technology will be made, also as discussed below.

#### **2.3.2.1 Decision Rules for Initial Characterization**

A general discussion of the rationale for selection of test pit samples is provided below, followed by the decision rule process steps. The basis for selection of samples is the presence of elevated concentrations of COCs compared to certain action levels.

The action levels for selecting samples with elevated concentrations for the treatability study during the initial characterization phase are based on COC concentrations that pose a potential risk based on residential exposure. It is reasonable to expect that if COC concentrations are at least an order of



magnitude greater than the USEPA Region 9 residential soil PRGs, then the concentrations are elevated enough to warrant testing in a treatability study. For lead, the treatability study action level represents the concentration an order of magnitude greater than the residential screening value used in the OU2 risk assessment. The action levels are as follows:

<b>COC</b>	<b>Action Level for Sample Selection</b>
Lead	4,000 mg/kg
Antimony	310 mg/kg
Benzo(a)pyrene	620 µg/kg
Aroclor-1254	2,200 µg/kg
2,3,7,8-TCDD	39 ng/kg

Three of the five composite samples collected from five test pits will be selected for the treatability study. The presence of elevated concentrations of lead and benzo(a)pyrene is considered important for selection of samples for the treatability study because these parameters are expected to be indicators for the performance of the other inorganic and organic COCs, respectively, during the treatability study. However, lead is expected to be the more widespread contaminant and therefore, it is more likely to determine the extent of contamination for a remedial action at OU2. Furthermore, because of the anticipated variability in physical characteristics between the composite samples, and in order to ensure that lead is adequately addressed during the treatability study, it is required that elevated levels of lead be present in at least two of the selected composite samples. It is preferable that elevated levels of benzo(a)pyrene be present in at least two of the selected composite samples, but this condition is less likely. Therefore, at least one selected composite sample should contain elevated levels of benzo(a)pyrene. It is also preferable, but not required, that at least one of the samples meeting the requirements for lead and benzo(a)pyrene also contain elevated levels of antimony and the other organic COCs.

Decision Rule Process Steps for Initial Characterization:

1. If elevated levels of indicator parameters for the treatability study (lead and benzo(a)pyrene) are present in the samples, then proceed with the treatability study. The requirement is at least two samples contain elevated levels of lead and at least one sample contain elevated levels of benzo(a)pyrene, when the concentrations are compared to the action levels presented in the table above. It is also preferable (not required) that elevated levels of antimony be present in samples containing elevated levels of lead and that elevated levels of the other organic COCs be present in the sample containing the elevated level of benzo(a)pyrene. Select three of the five samples that meet the above requirements (regarding lead and benzo(a)pyrene and preferences regarding the other COCs). If more than three samples meet the requirements regarding lead

and benzo(a)pyrene, and preferences regarding the other COCs, then of these samples, select three samples (preferably including one from Site 29) to represent a wider range of visually observed physical characteristics. If three of the five samples do not meet the requirements, go to Step 2.

2. If concentrations of lead and benzo(a)pyrene are less than the action levels in a sample, but concentrations of the other COCs are greater than the action levels in the sample, then consider whether to include the sample in the treatability study. (Favorable conditions to include this sample will be highly elevated concentration combined with physical characteristics that might provide useful information for evaluating the technology.) If none of the COCs are present at levels exceeding the action levels in any of the five composite samples, temporarily suspend work on the treatability study until a decision is made on the need for additional sample collection, and go to Step 3.
3. Determine whether additional sample collection is justifiable based on the project schedule. If justified, proceed with additional sample collection. If not, terminate the treatability study work.

#### **2.3.2.2 Decision Rules for Soil Washing Study**

The decision rule for assessing the potential effectiveness of soil washing for further evaluation based on the results of the remedy screening-level study is based on the USEPA guidance on soil washing (USEPA, September 1991), wherein it states, "A reduction of approximately 50 percent of the soil contaminants during the test indicates additional treatability studies are warranted." The guidance also states that a "separation of approximately 50 percent of the total soil volume as clean soil also indicates that remedy selection studies may be warranted."

##### Decision Rule Process Steps for Soil Washing:

Compare the concentrations of COCs in the untreated soil to those of the treated soil, and use professional judgment in making appropriate recommendations. Untreated soil is designated as the soil screened to remove debris larger than 1/2-inch mesh size obtained during the Test Samples Characterization (Task 1 discussed in Appendix C). Treated soil is designated as the sand, which is the end product of wet screening, following the density separation after "heavies" removal (at the end of Task 2C of Appendix C). Treated soil may also include the oversize fraction (+10 mesh) from wet screening, depending on its concentrations.

Professional judgment must be used in considering the number of samples where the concentrations of COCs has changed, whether the COCs are primary or secondary, the physical and chemical

characteristics of the soil, and the stage of the soil washing process where the greatest change in concentrations has been determined including supporting information regarding weights of various fractions. If a reduction in concentrations has been determined, then take the following actions:

- If concentrations of all COCs in all of the samples of untreated soil are reduced by 50 percent or greater to yield the treated soil, and the treated soil mass fractions are equal to or greater than 50 percent of their corresponding untreated soil masses, then recommend further evaluation of the technology for remedy selection at OU2.
- If concentrations of only primary COCs (lead and benzo(a)pyrene) in all of the samples of untreated soil are reduced by 50 percent or greater to yield the treated soil, and the treated soil mass fractions are equal to or greater than 50 percent of their corresponding untreated soil masses, then recommend further evaluation of the technology before testing for remedy selection at OU2. However, the recommendation must include an evaluation of the reasons for the limitations of the process and appropriate modifications to address the secondary COCs (Arochlor-1254 and 2,3,7,8-TCDD).
- If concentrations of the primary COCs (lead and benzo(a)pyrene) in one or two samples of untreated soil are reduced by 50 percent or greater to yield treated soil, and the treated soil mass fractions are equal to or greater than 50 percent of the their corresponding untreated soil masses, then recommend further evaluation of the technology before testing for remedy selection at OU2. However, the recommendation must include an evaluation of the reasons for the limitations of the process and appropriate modifications to address the other types of soil samples.
- If the concentrations of none of the primary COCs are reduced by 50 percent or greater in any of the samples, or the reduction in concentrations is not accompanied by the required recovery of 50 percent or greater of the treated soil mass fractions, then recommend no further evaluation of the technology in its currently proposed assembly of unit operations and processes.

TABLE 2-1

PROJECT SCHEDULE  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
Prepare Draft Work Plan	August 2004	October 2004	Report	October 1, 2004
Prepare Final Work Plan	October 2004	November 2004	Report	November 30, 2004
Sample collection	December 2004	December 2004	Field documentation <sup>(1)</sup>	See report <sup>(2)</sup>
Treatability Study testing	February 2005	March 2005	Report <sup>(3)</sup>	April 1, 2005
Draft Treatability Study Report	April 2005	May 2005	Report	May 2, 2005
Final Treatability Study Report	June 2005	July 2005	Report	July 5, 2005

- 1 The deliverable will not consist of a formal submittal. The information will be included in the Treatability Study Report.
- 2 Formal submittal date corresponds to the Treatability Study Report submittal.
- 3 Internal report from ART Engineering, LLC., to TtNUS.

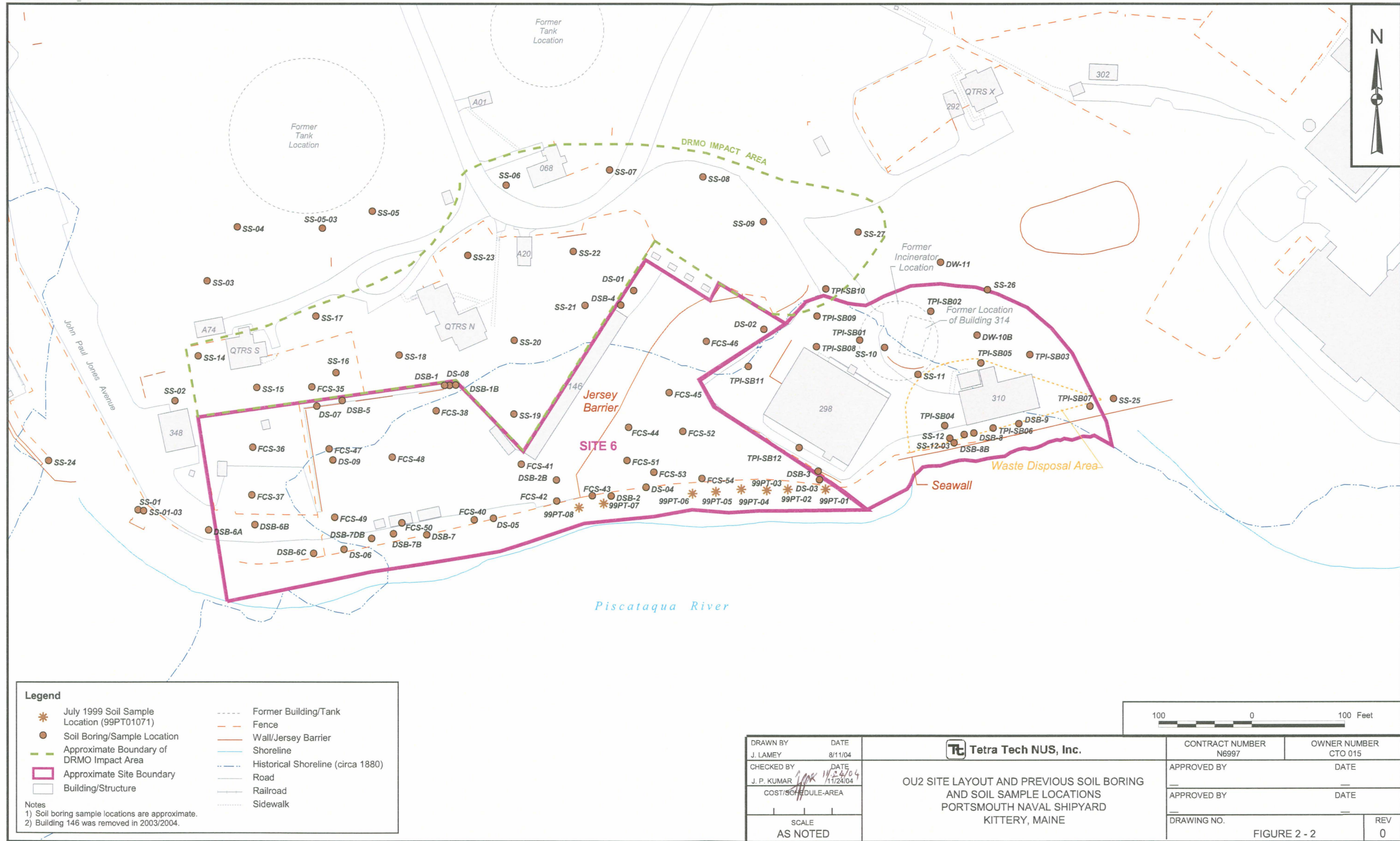
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### 3.0 FIELD INVESTIGATION RATIONALE, PROCEDURES, AND REQUIREMENTS

This section provides detailed discussions related to field investigation rationale, procedures, and requirements for the planned field investigation activities.

#### 3.1 FIELD INVESTIGATION RATIONALE

This section provides specific objectives and details of the rationale for each field investigation task. As outlined in Section 2.0, the overall scope of the investigation includes test pitting to collect large volume soil samples for the soil washing treatability study and laboratory analysis.

The information obtained during previous sampling activities was considered in the placement of the test pit locations. Figure 3-1 provides the planned locations for the test pits. Table 3-1 provides the test pit sample collection summary. Table 3-2 provides the sampling containers and preservation requirements. Perimeters of the test pits will be measured from known site features and recorded on site maps for use in the Treatability Study Report.

##### 3.1.1 Rationale for Test Pit Locations

Test pits will be used to provide bulk composite samples to assess the particle size fractions and material types for parameter correlations and for conducting the soil washing treatability study. The test pits will be in the general configuration of trenches, with the length of each trench greater than the width. Test pits are planned at locations selected based on high COC levels in historical sampling (see Figure 2-2 and Appendix A) and to obtain a variety of waste and soil types.

The test pits (OU2-TP101, -TP103, and -TP104) are planned to yield the primary samples to meet the decision rules for initial characterization. Two test pits (OU2-TP102 and -TP105) are planned to supplement or replace the primary samples. The following is the rationale for each test pit location:

- Test Pit OU2-TP101 is planned near the shoreline fence near wells DW-7 and DW-7B. Data at this location indicated elevated lead, Aroclor-1254, and benzo(a)pyrene concentrations in surface soil. Borings DSB-7 and DSB-7B indicated sand and cinders to 5 to 6 feet bgs, underlain by gravel-sized rock.
- Test Pit OU2-TP104 is planned in the capped area east of former Building 146. No previous borings have been located in this area, although surface samples DSB-3 and DS-03 collected during the Final Confirmation Study (Loureiro Engineering Associates, June 1986) indicated the highest lead



concentrations (130,000 mg/kg and 255,000 mg/kg, respectively). Minimal historical information, other than surface soil lead concentrations, is available in the capped area. This location is also close to one of the higher lead concentrations detected in the subsurface soil (24,200 mg/kg at TPI-SB12). Information on waste types, soil classifications, and contamination with depth, and large volume samples are needed to assess the suitability of soil washing.

- Test Pit OU2-TP103 is planned near the shoreline of Site 29 west of wells DW-8 and DW-8B. Previous borings indicate that the highest lead and antimony concentrations at Site 29 occur along the shoreline at depths greater than 2 feet. Boring DSB-8B indicated sand with metal debris to greater than 10 feet bgs. Borings TPI-SB04 and TPI-SB06 indicate ash/cinders with metal to depths greater than 10 feet bgs. Test pit OU2-TP103 will be located near the seawall just far enough west of Building 310 to allow access.
- Test Pits OU2-TP102 and OU2-TP105 are located close to the previously detected high concentrations of lead in subsurface soils. Samples from these locations are expected to be supplemental or replacement samples for OU2-TP104 to represent the previously detected high lead concentrations in subsurface soil.

The depth of excavation for the test pits will be limited to the water table, 10 feet, or bedrock, whichever is shallowest. The test pits located along the shoreline may be within a tidally influenced groundwater zone; therefore, the timing of the test pitting will take into account groundwater fluctuation (i.e., work near or at low tide). The approximate depth of low-tide groundwater is expected to be 8 to 10 feet bgs.

## **3.2 SOIL SAMPLING**

Soil sampling at the OU2 will take place during test pitting. Each sample will be collected as a composite of material excavated from a test pit.

### **3.2.1 Test Pits**

The objective of excavating the test pits is to retrieve bulk composite samples for the soil washing treatability study. A second objective is to obtain samples of blast rock and debris, because historical soil borings have had poor recovery in these materials. A total of five test pits (OU2-TP101 through OU2-TP105) will be excavated to a depth of 10 feet, groundwater, or top of bedrock, whichever is shallower. Test pits will be field located by the TtNUS FOL (or designee). Variations from the proposed test pit locations shown on Figure 3-1 cannot be beyond those areas cleared for utilities. The test pits will be a minimum of 10 feet long and 2 feet wide, as necessary, to observe and sample to the maximum depth.

At all test pits, the existing clean cover (rock at OU2-TP101, cemented crushed rock at OU2-TP102 and OU2-TP-105, and topsoil at OU2-TP103) will be separated from the rest of the material (i.e., placed to one side of the test pit) so that this clean material can be replaced, if practical, during backfilling. At test pits OU2-TP102 and OU2-TP-105, the design drawings indicate a 12-inch-thick layer of “crushed rock choked with cement” over a GCL. Previous site visits indicate that some areas of this cap have hardened significantly. During cap removal, cutting the GCL will be preferred instead of pulling or tearing, thereby attempting to limit the area of damage to the GCL within the footprint of the test pit. A sample of excavated GCL will be retained for visual observation; the remainder will be disposed of with personal protective equipment.

A barrier (i.e., plastic sheeting) will be placed on the existing ground surface (opposite of the side designated for the clean cover layer) as the test pitting operation proceeds. Excavated material will be placed in segregated stockpiles. Historical sampling indicates that the highest contaminant levels may be within the top 2 feet of material beneath the cover. Stockpiles will be determined by the FOL, as follows: (1) one stockpile for each 2-foot depth interval or (2) one stockpile for each distinct soil/waste type, based on visual observation. Each stockpile depth interval will be marked. All excavated material (below the clean cover material) will be contained on and within the barrier. Caution will be taken during construction of test pits to avoid damage to monitoring wells.

The TtNUS FOL (or designee) will observe the test pitting work and will be responsible for completing a test pit log for each test pit. The test pit log will document the visual classification of soils/fill in accordance with the Unified Soil Classification System (USCS) (SOP SA-1.3) (presented in Appendix B), changes in strata, depth and description of metallic and non-metallic objects, and the depth of groundwater encountered during test pit excavation.

The excavation will occur in several increments of depth. After each increment, the operator will wait while the TtNUS FOL inspects the test pit to observe subsurface conditions. The backhoe operator, who will have the best view of the test pit, will temporarily suspend operation if any of the following are encountered:

- Groundwater
- Utility lines

Field decisions made by the TtNUS FOL in consultation with the TtNUS PM and the Navy may also be required during excavation of the test pits.

### **3.2.2.1 Recording**

Features exposed in the test pits will be logged as these are excavated. Records of each test pit will be made on test pit logs (Appendix B) or in a field notebook. If the log is made in a fieldbook, it will contain the same information required by the form. Procedures outlined in SOP SA-6.3 will be followed.

At a minimum, the test pit log will include the following information:

- Plan and profile sketches of the test pit showing materials encountered, and the depth, distribution, and location of these materials in the test pit.
- A sketch of the test pit location showing permanent and identifiable location marks.
- Identification of lithologies with delineation between fill and natural materials.
- An estimate of rock particle size and where blast rock is encountered.
- An estimate of percentage of fill that consists of wire, wood, metal debris, etc.
- The presence or absence of groundwater or surface water entering the pit.
- Any odors, staining, or other evidence of potential environmental contamination encountered.

### **3.2.2.2 Sampling Procedures**

Samples for visual classification will be obtained by the TtNUS FOL from the bucket of the excavator. Personnel will not enter the test pit trench. The TtNUS FOL will direct the operator to remove material from the selected depth or location within the test pit. The bucket will be brought to the surface and moved away from the pit edge to allow collection of the sample.

Excavated material will be placed in segregated stockpiles, as described above. Each 2-foot layer or distinct stratum (as determined by the TtNUS FOL) will be mixed and stockpiled manually using shovels or using the excavator's bucket to the extent practical. Material from the each stockpile will be visually classified and detailed on the test pit log form. Approximately one excavator bucket volume of the material will be removed from each stockpile and mixed to form a stock pile that will represent the various strata from a test pit.

One representative sample will be taken from each test pit (from its representative stockpile) to create a 5-gallon composite sample for initial characterization. A total of five composite samples will be collected (one from each of five test pits), and all five composite samples will be sent to ART Engineering, LLC., for preparation of the soil samples for initial characterization, as described in Appendix C.

During excavation, dust control measures will be taken as necessary. Erosion control measures (using hay bales and silt curtains) will be taken in the Site 29 area.

### **3.2.2.3 Test Pit Restoration**

Upon completion of each test pit excavation, the test pit will be backfilled with the material excavated from that location. Stockpiled material will be returned to the test pit from which it originated, at the depth interval from which it was removed. In particular, segregated material from the top 2 feet of fill will be replaced in the top 2 feet beneath the clean cover. Compaction of the backfill material will be achieved using the bucket and tracks of the excavator. Investigation-derived waste (IDW) will be managed as discussed in Section 3.3.4. The top 1 foot of each excavation will be backfilled with materials consistent with the existing site surface. Segregated original cover materials will be replaced, as practical.

After the test pit fill is replaced to the approximate original fill elevation at OU2-TP102, OU2-TP104, and OU2-TP105, the surface of the fill will be well compacted to create a firm subgrade for the restored cap. Adjacent cemented rock cover will be removed a minimum of 12 inches beyond each side of the test pit to allow a minimum 12-inch overlap of GCL. New GCL (manufactured with geotextile on both sides) will be laid over the compacted fill and the adjacent exposed old GCL. Seams will be constructed by overlapping GCL edges. Care will be taken so that the overlapping zone does not have loose soil or other debris between the GCL layers. If the test pit width plus overlap is less than one GCL roll width, GCL will be laid over the trench lengthwise. If the test pit width plus overlap is greater than one GCL roll width, GCL will be laid perpendicular to the trench length, with several short seams, to avoid one long seam along the length of the trench. Seams and overlaps will be a minimum of 12 inches wide and will be supplemented with granular bentonite at a minimum application rate of one-half pound per linear foot. Following placement of the GCL, a 12-inch layer of crushed rock choked with cement will be placed.

After a test pit has been sampled and backfilled, it will be identified by a wooden stakes driven into each corner of the test pit (four stakes). The location of each test pit will be clearly explained in the test pit logs. The stakes will have both brightly colored flagging attached to increase visibility and will be labeled using a waterproof marker with the test pit number. Measurements of the test pit dimensions and locations will be taken from known site features.

### **3.3 OTHER FIELD INVESTIGATION ACTIVITIES**

Other field investigation activities include obtaining site utility clearance and digging permits, cleaning and decontaminating equipment, inspecting and accepting supplies/sample containers, and managing IDW.

### **3.3.1 Site Utility Clearance and Digging Permit**

Before any test pitting activities commence at the site, utility maps of the facility will be obtained and thoroughly reviewed. Utility clearance will be conducted by a PNS contractor who will certify that the planned locations are acceptable.

### **3.3.2 Cleaning and Decontamination of Equipment**

The equipment used during the field activities will be decontaminated prior to and during excavation and sampling activities. This equipment includes the backhoe or other heavy equipment bucket and soil sampling and compositing equipment. A decontamination pad will be necessary for decontaminating heavy equipment. All excavation equipment that comes in contact with the subsurface shall be steam cleaned prior to beginning work, between test pits, any time the heavy equipment leaves the site prior to completing a test pit, and at the conclusion of the test pitting program.

TtNUS will obtain precleaned sample containers from ART Engineering, LLC., for sample transport to the laboratory for analyses. These containers will meet the requirements of the USEPA Specification and Guidance for Contaminant-Free Sample Containers [Office of Solid Waste and Emergency Response (OSWER) Directive No. 9240.0-05A].

Any nondedicated sampling equipment used will be decontaminated both prior to beginning field sampling and between samples. The following decontamination steps will be conducted:

- Potable water rinse
- Alconox or Liquinox detergent wash
- Potable water rinse
- Analyte-free water rinse
- Isopropanol rinse
- Analyte-free water rinse
- Air dry

If the equipment is new, the initial cleaning will consist only of a soapy water wash followed by tap water and distilled water rinses. Disposable sampling materials (e.g., polyethylene spoons or bowls) that are individually packaged from the factory will not require decontamination before sampling.

Additional requirements for sampling equipment decontamination can be found in SOP SA-7.1, which is provided in Appendix B.

**3.3.3      Inspection and Acceptance Requirements for Supplies/Sample Containers**

It will be the responsibility of the TtNUS FOL (or designee) to inspect all supplies to be used as part of the field program during mobilization and use. Supplies to be inspected include sampling equipment and sample containers. If the TtNUS FOL encounters any problem with the supplies, he or she will inform the TtNUS PM and the laboratory supplying the containers. The TtNUS PM, in consultation with the Navy RPM and QA/QC Officer, will instruct the FOL on any corrective actions that will be implemented.

**3.3.4      Management of IDW**

Five types of IDW will be generated during this investigation that could be potentially contaminated: soil/fill material from test pits, decontamination wastewater, sampling equipment decontamination wastewaters, GCL, and PPE. In addition, cemented rock from the capped area that is not replaced will require disposal, but this material is expected to be nonhazardous. Based on the historical site activities and types of contaminants present, none of these IDW materials is expected to present a significant risk to human health or the environment if properly managed.

Solid IDW will be placed in properly labeled 55-gallon, sealable steel drums. The drum(s) of soil IDW will be sealed and transported to a central location at the PNS designated by the Navy. Any cemented rock material that cannot be reused, are expected to be nonhazardous, and should be disposed as nonhazardous waste.

Any IDW soils or water will be sent to the PNS hazardous waste transfer facility for sampling and analysis. The waste will be properly disposed by the Navy based on the results of this analysis.

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TABLE 3-1

SUMMARY OF TEST PIT SAMPLING  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Sample Location	Sample ID	Sample Depth (ft bgs)
TP-101	OU2-TP1010010 <sup>(1)</sup> (composite)	0 to 10
TP-102	OU2-TP1020010 <sup>(1)</sup> (composite)	0 to 10
TP-103	OU2-TP1030010 <sup>(1)</sup> (composite)	0 to 10
TP-104	OU2-TP1040010 <sup>(1)</sup> (composite)	0 to 10
TP-105	OU2-TP1050010 <sup>(1)</sup> (composite)	0 to 10

Notes:

1. Analytical program is defined in Appendix C.



**TABLE 3-2**  
**SAMPLE CONTAINERS AND PRESERVATION REQUIREMENTS**  
**OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Analytical Method	Parameter	Container Material	Container Volume <sup>(1)</sup>	Preservation	Holding Time <sup>(2)</sup>
<b>SOIL SAMPLES</b>					
SW-846 6010B	Lead	Clear wide mouth jar	4 oz.	Cool to 4° C	180 days to analysis
SW-846 6010B	Antimony	Clear wide mouth jar	4 oz.	Cool to 4° C	180 days to analysis
SW-846 8082	Aroclor <sup>(3)</sup>	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction; 40 days to analysis
SW-846 8270C SIM	PAHs <sup>(4)</sup>	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction; 40 days to analysis
SW-846 8290	2,3,7,8-TCDD <sup>(5)</sup>	Clear wide mouth jar	4 oz.	Cool to 4° C	30 days to extraction; 45 days to analysis

1 Container volume may vary based on laboratory.

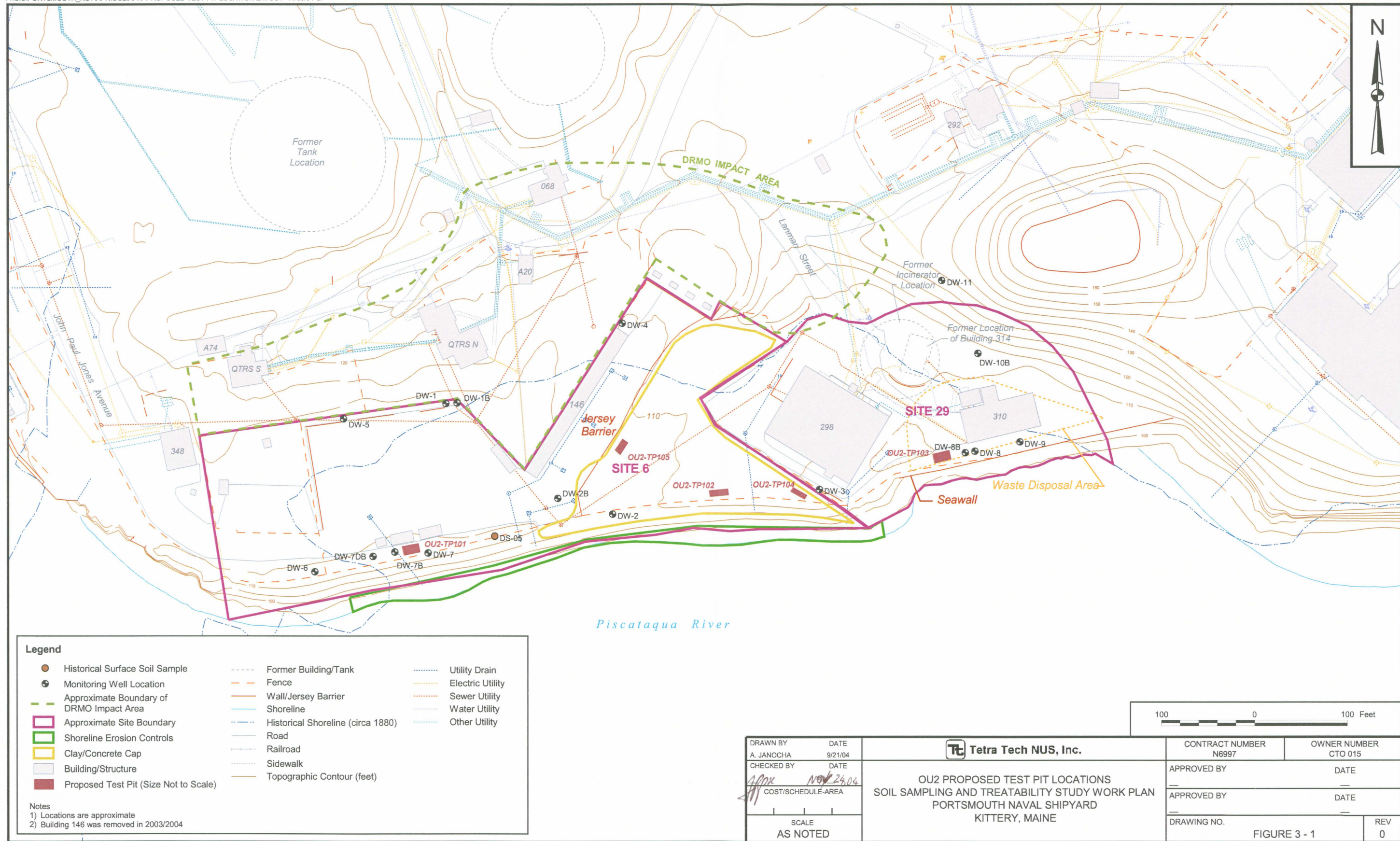
2 Measured from time of sample collection.

3 Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260. Aroclors are PCBs.

4 Anthracene, pyrene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, fluoranthene, benzo(k)fluoranthene, acenaphthylene, chrysene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(a)anthracene, acenaphthene, phenanthrene, fluorene, naphthalene, 2-methylnaphthalene.

5 2,3,7,8-TCDD is a dioxin.

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## **4.0 SAMPLE HANDLING, TRACKING, AND CUSTODY REQUIREMENTS**

The sample handling, field documentation, and chain-of-custody procedures for this investigation are documented in this section.

### **4.1 SAMPLE COLLECTION DOCUMENTATION**

The following sections outline the procedures that will be used by field personnel to document project activities and sample collection procedures. Detailed and accurate documentation is necessary to ensure data integrity.

#### **4.1.1 Field Notes**

Documentation of field observations will be recorded in a field logbook and/or field log sheets including sample collection logs, boring logs, and test pit logs. Bound, water-resistant field logbooks will be utilized during this project. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink. Field logbooks will be maintained according to SOP SA-6.3. Field sample log sheets will be used to document sample collection details. Other observations and activities will be recorded in the field logbook.

For sampling and field activities, the following types of information will be recorded as appropriate:

- Site name and location
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions
- Activities involved with sampling
- Subcontractor information
- Site observations including site entry and exit times
- Site sketches
- Visitors
- Health and safety issues including PPE
- Log of photographs, if any

The following sections outline the information that will be documented in the field according to the activities to be performed.

#### **4.1.2      Field Documentation Management**

After the investigation is completed, the field sampling log sheets will be organized by date and placed in the project file. The field logbooks for this project will be used only for this site and will also be categorized and maintained in the project file after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be given titles based on date and activity.

### **4.2            SAMPLE HANDLING AND CUSTODY**

Sample custody procedures are designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. Field chain-of-custody procedures are described in SOP SA-6.3.

Integrity of the samples collected during the site investigation will be the responsibility of identified persons from the time the samples are collected until their derived data are incorporated into the final report. Stringent chain-of-custody procedures will be followed to document sample possession.

#### **4.2.1      Field Custody**

The FOL is responsible for the care and custody of the samples collected until they are delivered to the treatability study facility or are entrusted to a carrier.

Sample logs or other records will be signed and dated by the persons making the entries.

Chain-of-custody forms will be completed to the fullest extent possible before sample shipment. They will include the following information: project name, sample number, date and time collected, analysis to be conducted, description of sample location, sample depth, matrix, type of sample, grab or composite designation, preservative, and name of sampler.

These forms will be filled out in a legible manner using waterproof ink and will be signed by the sampler. Similar information including the analyses to be conducted will be provided on the sample label, which will be securely attached to the sample container. In addition, sampling forms will be used to document collection and preparation procedures. Copies of all forms to be used during field activities are provided in Appendix B.

#### **4.2.2      Transfer of Custody**

The following procedures will be used when transferring custody of samples:



- Samples will be custody-sealed for security according SOP SA-6.3 and accompanied by a chain-of-custody form. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This record documents the sample custody transfer from the sampler to the treatability study facility and subsequently to the laboratory, often through another person or agency (common carrier).
- Prior to shipment to the treatability study facility and subsequently to the laboratory for analysis, samples will be properly packaged. Individual custody records will accompany each shipment. Shipping containers will then be sealed for shipment. The methods of shipment, courier name, and other pertinent information will be entered in the “remarks” section of the custody record.
- All shipments will be accompanied by the chain-of-custody form identifying the contents. The original record will accompany the shipment, and a copy will be retained by the field sampler or treatability study facility.
- Proper documentation will be maintained for shipments by common carrier.

#### **4.2.3      Sample Shipment Procedures**

The following procedures will be followed when shipping samples to the treatability study facility or subsequently to the laboratory for analysis:

Samples requiring cooling to 4 degrees Celsius (°C) will be promptly chilled with ice and packaged in an insulated cooler for transport to the laboratory. A temperature blank will be included in each cooler to be used as a temperature indicator. Each temperature blank will be clearly identified by the field sampling team. Ice will be sealed in containers to prevent leakage of water. Samples will not be frozen.

Only shipping containers that meet all applicable State and federal standards for safe shipment will be used.

The field chain-of-custody form will be placed inside the shipping container in a sealed, plastic envelope. Shipping containers will be sealed with nylon strapping tape, and custody seals will be signed, dated, and affixed in a manner that will allow the receiver to quickly identify any tampering that may have occurred during transport to a facility.

Samples delivery to the facility will be made by a public courier. After samples have been prepared by the treatability study subcontractor, they will be sent to the laboratory within 72 hours. Under no circumstances will sample holding times be exceeded at the laboratory.

#### **4.2.4 Field Documentation Responsibilities**

It will be the responsibility of the TtNUS FOL to secure all documents produced in the field (e.g., sampling logs, calibration forms) at the end of each work day. Copies of all forms to be used during field activities are included in the SOPs in Appendix B. Copies of all field logbooks will be sent to EFANE to the attention of Mr. Fred Evans (Navy RPM). Sample logs, chain-of-custody records, and test pit logs will be included in an appendix to the report that will be prepared based on results of this investigation.

At the completion of field activities, the TtNUS FOL will send Ms. Deborah Cohen (the TtNUS PM) or her designee all field records, data, field notebooks, logbooks, chain-of-custody forms, sample log sheets, daily logs, etc. The PM will ensure that these materials are entered into the TtNUS document control system in accordance with appropriate administrative guidelines.

Changes in project operating procedures may be necessary as a result of changed field conditions or unanticipated events. A summary of the sequence of events associated with field changes is as follows:

- The TtNUS FOL (or designee) will communicate to the TtNUS PM and TtNUS Task Manager the need for the change.
- If necessary, the TtNUS PM will discuss the change with the pertinent individuals (e.g., Navy RPM, TtNUS Task Manager, TtNUS QA Officer, TtNUS Health and Safety Officer) and will provide a verbal approval or denial to the TtNUS FOL for the proposed change. The USEPA and MEDEP will be consulted by the Navy as to any major scope changes that may occur while field work is ongoing. Communications and correspondences to the RAB will be handled through inclusion on the distribution list or written correspondence and updates at RAB meetings.
- The TtNUS FOL will document the change on a Task Modification Request Form and forward the form to the TtNUS PM at the earliest convenient time.
- The TtNUS PM will sign the form and distribute copies to the Navy RPM, QA Manager, TtNUS FOL, and project file.
- A copy of the completed Task Modification Request Form will be attached to the field copy of the affected document.

#### 4.2.5 Sample Custody

To ensure the integrity of a sample from collection through analysis, it is necessary to have an accurate, written record that traces the possession and handling of the sample. This documentation is referred to as the chain-of-custody form.

A sample is under custody if:

- The sample is in the physical possession of an authorized person.
- The sample is in view of an authorized person after being in his/her possession.
- The sample is placed in a secure area by an authorized person after being in his/her possession.
- The sample is in a secure area restricted to authorized personnel only.

When samples are received at the laboratory or at the treatability study facility, the chain-of-custody form is signed and dated to acknowledge sample receipt. The sample custodian must examine the shipping containers and verify that the correct number of containers was received. The shipping containers are then opened, and the enclosed sample paperwork is removed. Samples are removed from the shipping containers and the bottle condition and temperature of the temperature blank must be noted. The information on the chain-of-custody, the airbill, container labels, and laboratory request is reviewed by the sample custodian to note any discrepancies.

The facilities will be required to fax the chain-of-custody forms and sample log-in information to the TtNUS PM after every shipment.

All samples received by the facilities must be stored at 4°C until analysis. The laboratory sample holding times are specified by the contract and presented in Table 3-2.

#### 4.3 **SAMPLE IDENTIFICATION SYSTEM**

All environmental samples collected at OU2 will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number. The sample tracking number will consist of a four-segment alphanumeric code that identifies the sample's associated site, sample type, and location. A similar sample nomenclature will be used for samples generated during the soil washing treatability study.

The alphanumeric coding to be used in the OU2 sample system is as follows:

<b>AAN</b>	<b>AA</b>	<b>NNN</b>	<b>NNNN (for TP) or A (for TS)</b>
Site	Sample Type	Location	Depth Interval (for TP)
			Treatment Fraction (for TS)

**Character Type:**

A = Alpha  
N = Numeric

**Site:**

OU2 = Operable Unit 2

**Sample Type:**

TP = Test pit sample  
TS = Treatability Study

**Location:**

The sample location code will begin with 101, be numbered sequentially, and result in a unique sample location code at each sample location. Sample location codes will be numbered prior to field work based on the proposed sampling locations presented on Figure 3-1.

**Depth Interval for Test Pit Sample or Treatment Fraction for Treatability Study Samples:**

For test pit samples, the depth code is used to note the depth in feet bgs at which a soil sample is collected. The first two numbers of the four-number code specify the top of the interval, and the third and fourth numbers specify the bottom depth of the soil sample. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

For treatability study samples, the code will be an alpha character corresponding to the fraction generated during the treatment process (as detailed in the flow chart and table in Appendix C).



**Depth (for soils, in feet bgs):**

0008 = Soil composite from 0 to 8 foot bgs

0110 = Soil composite from 1to 10 feet bgs

**Examples of Sample Nomenclature**

A test pit sample from OU2-TP101 at an interval of 0 to 8 feet bgs would be designated as OU2-TP1010008.

**4.4 FIELD QUALITY CONTROL SAMPLES**

Only temperature blanks will be generated. Temperature blanks are vials of water inserted into each sample cooler prior to shipment from the field. The temperature of the temperature blank is measured prior to shipment and upon receipt at the laboratory to assess whether samples were properly cooled during transit. Temperature blank requirements are summarized on Table 4-1.

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**TABLE 4-1**  
**FIELD QC SAMPLES**  
**OU2 SOIL SAMPLING AND ANALYSIS WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Field QC	Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Cooler Temperature Blank	1 per cooler	4° C, ± 2° C	Re-sample or qualify the data	Data validator, field sampler	Accuracy/bias/ preservation	4° C, ± 2° C

Note:

SOP -

CA - QC - Quality Control

RPD - Relative Percent Difference

QL - Quantitation Limit

Performance Evaluation Samples (PES) are not required for this project because the selected laboratory (Katahdin Analytical Services) participated in and passed an Naval Facilities Engineering Services Center (NFESC) audit in 2001, which required evaluation of PES. Results of the evaluation are available from the laboratory.

## **5.0 FIXED-BASED LABORATORY ANALYTICAL PLAN**

This section of the work plan describes the analytical plan that will be used by the fixed-based laboratory to generate data for the project. The section documents the fixed-based laboratory analytical methods and SOPs that will be used to meet measurement performance criteria and to achieve project-required quantitation limits for the site-related contaminants.

### **5.1 METHOD DETECTION/QUANTITATION LIMITS**

The analytical methods to be used for analysis of the samples were selected based on the existing analytical data. The suite of analyses includes lead and antimony by SW-846 6010B, PAHs by SW-846 8270C Selective Ion Monitoring (SIM), polychlorinated biphenyls (PCBs) by SW-846 8082, and 2,3,7,8-TCDD by SW-846 8290 (see Table 3-1 and Table 3-2 for specific locations and analyses, respectively).

The aforementioned parameters will be used to characterize test pit samples and to evaluate the efficiency of the soil washing treatability process. Tables 5-1 through 5-4 provide summaries of all target analytes and associated practical quantitation limits (PQLs), instrument detection limits (IDLs), and method detection limits (MDLs). Analytical methods are further discussed in Section 5.2.

### **5.2 ANALYTICAL METHODS/SOPs AND MODIFICATIONS**

Analytical methods to be used by Katahdin Analytical Services (and their subcontractor Triangle Laboratories, Inc. for dioxin analyses) and their associated SOPs for soil are presented in Table 5-5. Analytical laboratory SOPs have already been provided under separate cover.

The analyses of lead, antimony, PAHs, PCBs (Aroclors), and 2,3,7,8-TCDD will be performed without modification to the standard analytical methods.

### **5.3 CALIBRATION AND PREVENTATIVE MAINTENANCE OF LABORATORY INSTRUMENTS**

To ensure that the methods performed by the laboratories meet the project requirements for selective, sensitive, accurate, and precise detection and quantitation of the chemicals at OU2, the calibration procedures will follow the requirements summarized in Table 5-6.

The procedures will be followed by Katahdin Analytical Services (and their subcontractor Triangle Laboratories, Inc.) to ensure that the laboratory instruments are available and in working order to meet the required turnaround times for these analyses. The procedures are included in SOPs listed in Table

5-5, and the instrument and equipment, maintenance, testing, and inspection requirements are presented in Table 5-6 of this work plan.

The laboratories check the instruments used for the analyses, as described in Table 5-6 of this work plan. The instruments are monitored daily for potential failure. The analysis of internal blanks and control standards at the beginning and end of each day provides real-time information to the analyst on the conditions of the instruments. Equipment maintenance logs are maintained for the Inductively Coupled Plasma (ICP) and all other instruments used.

#### **5.4 INTERNAL QUALITY CONTROL CHECKS**

Katahdin Analytical Services and Triangle Laboratories, Inc. operate QC programs that assure data users of the reliability and validity of the analyses performed at the laboratories. Each laboratory's QA plan describes the policies, organization, objectives, QC activities, and specific QA functions used by that laboratory. All analytical procedures are documented as SOPs. Each analytical SOP specifies minimum QC requirements for the procedure. Table 5-5 lists the SOPs associated with each analytical procedure. In addition, the laboratories maintain SOPs regarding general laboratory QA operations.

Internal laboratory analytical QC requirements and those used for instrument calibration QC are discussed in the remainder of this section. Additional QC requirements specific to the Naval Facilities Engineering Service Center (NFESC) QA Program are also specified, as applicable, for each of the QC checks. Target precision and accuracy values (control limits) are presented in Tables 5-7 and 5-8. The applicable analytical SOPs should be consulted for calibration QC measures.

##### **5.4.1 Laboratory Control Samples**

Laboratory control samples (LCSs) provide a means to monitor the overall performance of each step during the analysis, including the sample preparation. These are solid samples (soil analyses) that contain concentrations of analytes that are known with a specified degree of certainty.

Based on the requirements of the NFESC QA Program, LCSs for metals analyses must contain all analytes of interest.

Based on NFESC QA Program requirements, if recovery of an LCS falls outside the control limits, the laboratory will reject the data for the analytical batch and take corrective action. The associated samples, extracts, or digestates may be reanalyzed a single time, and, if the LCS recoveries meet acceptance criteria, the data will be reported. If LCS analyte recovery is still outside the acceptance limits, the associated samples in the preparation batch will be reprocessed, if sufficient sample is available and

holding times have not lapsed. If re-preparation or reanalysis is not possible, the data will be flagged, and the sample delivery group (SDG) narrative will include details of the failed LCS.

#### **5.4.2      Laboratory Duplicates**

Laboratory duplicates will be analyzed for metals to measure the cumulative uncertainty (i.e., precision) of the sample handling, subsampling, preparation, storage, and analysis operations within the laboratory, as well as sample heterogeneity that is not eliminated through simple mixing in the laboratory. Laboratory duplicates are two subsamples obtained by the laboratory analyst after the sample is mixed. If chemical analysis relative percent difference (RPD) values exceed QC limits for laboratory duplicates, the analytical process will be investigated to assess whether the observed RPD is an indication of a deficient analytical system or of excess sample heterogeneity.

#### **5.4.3      Laboratory Method Blanks**

A laboratory method blank or preparation blank is an analyte-free matrix prepared and analyzed in accordance with the analytical method employed to determine whether contaminants originating from laboratory sources have been introduced and have affected environmental sample analyses. Native soils devoid of acid-leachable metals do not exist. Therefore, a method blank for soil sample analysis consists of an aliquot of analyte-free water that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. The aqueous results are normalized to a fictitious soil sample and presented on a dry-weight basis assuming 100 percent solids.

Acceptance criteria for laboratory method blanks and corrective actions for non-compliant results are described in the applicable analytical SOPs, which have been provided under a separate cover. Under no circumstances should laboratory method blank contaminant values be subtracted from environmental sample analytical results.

#### **5.4.4      Matrix Spikes**

Matrix spikes (MSs) are environmental samples to which known quantities of analytes are added prior to sample preparation (digestion or extraction). These samples provide information about the heterogeneity of the samples as well as the effect of the sample matrix on the sample digestion and measurement methodology.

To conform to NFESC requirements, MSs will contain as many representative analytes as practicable. For many analyses, the spiking list will consist of most or all the target analytes.

If the MS recovery is not within applicable control limits, the laboratory will assess the batch to determine whether the spike results are attributable to a matrix effect or are the result of other problems in the analytical process. Based on NFESC requirements, if all the batch QC elements that are not affected by the sample matrix are in control (e.g., method blank, LCS, calibration checks) and if no evidence shows that spiking was not properly performed, the poor spike recovery may be attributed to matrix effects. In this case, the associated data will be flagged, but re-preparation and reanalysis will not be required. If any of the batch QC elements that are not affected by the sample matrix are out of control, or if any evidence shows that spiking may have been improperly performed, the MS sample will be reprocessed through the entire analytical sequence. If insufficient sample is available or if holding times have passed, the laboratory will flag the associated data. Details of noncompliant and laboratory duplicate results will be included in the SDG narrative.

#### **5.4.5      Post-Digestion Spikes**

Post-digestion spikes (PDSs) are similar to MSs except that the sample digestate, rather than the original soil sample, is spiked. These spikes are analyzed only for metal target analytes if the MS recovery falls outside control limits. Comparing percent recoveries for PDSs and MSs helps to identify where in the analytical process accuracy problems are occurring. PDSs will contain all target analytes of interest and will be used to assist in determining whether unacceptable MS recoveries are a result of matrix effects.

#### **5.4.6      Performance Evaluation Samples**

The selected laboratory needs to be Navy certified, which requires the evaluation of performance evaluation samples (PES) including the analyses that will be performed in this investigation. Results of the PES evaluation should be available from the laboratory.

### **5.5            REQUIREMENTS FOR SUPPLIES/SAMPLE CONTAINERS**

All supplies used by the laboratories will be free of contaminants of concern, other target compounds, and interferences. Method blanks will be performed at the rate specified in each method to ensure that reagents and equipment are free of contamination. The corrective actions specified in the laboratory statements of work will be followed if laboratory contamination is detected.

TABLE 5-1

QUANTITATION LIMITS FOR PAH PARAMETERS IN SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD  
KITTERY, MAINE

Parameter (SIM 8270 Method)	PQL <sup>(1)</sup> (µg/kg)	Achievable Laboratory MDLs <sup>(2)</sup> (µg/kg)	Target Quantitation Limits <sup>(3)</sup> (µg/kg)	Footnote Ref
Acenaphthene	330	0.70	370,000	N
Acenaphthylene	330	0.53	370,000 <sup>(4)</sup>	NA
Anthracene	330	0.81	2,200,000	N
Benzo(a)anthracene	330	1.01	620	C
Benzo(a)pyrene	330	0.75	62	C
Benzo(b)fluoranthene	330	2.05	620	C
Benzo(g,h,i)perylene	330	1.71	230,000	NA
Benzo(k)fluoranthene	330	1.35	6,200	C
Chrysene	330	1.23	62,000	C
Dibenz(a,h)anthracene	330	2.00	62	C
Fluoranthene	330	1.64	230,000	N
Fluorene	330	0.61	260,000	N
Indeno(1,2,3-cd)pyrene	330	2.01	620	C
2-Methylnaphthalene	330	0.56	5,600	NA
Naphthalene	330	0.89	5,600	N
Phenanthrene	330	1.47	230,000 <sup>(5)</sup>	NA
Pyrene	330	1.80	230,000	N

Notes:

C = Carcinogenic risk.

N = Non-carcinogenic risk.

NA = Not applicable.

1 Practical quantitation limits (PQLs) are from Method SW 846 8270C.

2 Method Detection Limits (MDLs) provided by Katahdin Analytical Services. MDLs are from Method SW846 8270C SIM. The laboratory will report nondetected values down to an adjusted MDL that will be agreed upon by the laboratory and TtNUS and will be less than the PQL.

3 Target Quantitation Limit has been selected to be more stringent than a potential cleanup level to allow for an estimation of efficiency of contaminant reduction during the treatability study. These limits are based on USEPA Region 9 Residential Preliminary Remediation Goal (PRG). One-tenth of the PRG value is presented for non-carcinogens.

4 Value listed is for the surrogate acenaphthene.

5 Value listed is for the surrogate pyrene.



TABLE 5-2

QUANTITATION LIMITS FOR PCB PARAMETERS IN SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD  
KITTERY, MAINE

Parameter	PQL <sup>(1)</sup> (µg/kg)	Achievable Laboratory MDLs <sup>(2)</sup> (µg/kg)	Target Quantitation Limit <sup>(3)</sup> (µg/kg)	Footnote Ref
Aroclor-1016	33	10.53	3,900	C
Aroclor-1221	67	8.19	220	C
Aroclor-1232	33	5.28	220	C
Aroclor-1242	33	6.75	220	C
Aroclor-1248	33	8.26	220	C
Aroclor-1254	33	4.7	220	C
Aroclor-1260	33	8.58	220	C

Notes:

C = Carcinogenic risk.

- 1 Practical quantitation limits (PQLs) are from Method SW 846 8082.
- 2 MDLs provided by Katahdin Analytical Services. MDLs are from Method SW 846 8082. The laboratory will report nondetected values down to an adjusted MDL that will be agreed upon by the laboratory and TtNUS and will be less than the PQL.
- 3 Target Quantitation Limit has been selected to be more stringent than a potential cleanup level to allow for an estimation of efficiency of contaminant reduction during the treatability study. These limits are based on USEPA Region 9 Residential Preliminary Remediation Goal (PRG).

TABLE 5-3

QUANTITATION LIMITS FOR METALS IN SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY MAINE

Analyte	Achievable Laboratory IDLs <sup>(1)</sup> (mg/kg)	Target Quantitation Limit <sup>(2)</sup> (mg/kg)	Footnote Ref
Antimony	0.207	3.1	N
Lead	0.139	400	NA

Notes:

N = Noncarcinogenic risk.

IDL = Instrument detection limit.

NA = Not Applicable.

- 1 Concentrations will be reported to adjusted IDLs provided by Katahdin Analytical Services. Actual reporting limits will vary depending on dilutions and other factors. The laboratory IDLs are identical to the analytical method IDLs. The laboratory is required to report to IDLs, but the IDLs are expected to be adjusted upwards by as much as a factor of 5 because of interferences.
- 2 Target Quantitation Limit has been selected to be more stringent than a potential cleanup level to allow for an estimation of efficiency of contaminant reduction during the treatability study. These limits are based on USEPA Region 9 Residential Preliminary Remediation Goal (PRG). One-tenth of the PRG value is presented for non-carcinogens.

TABLE 5-4

QUANTITATION LIMIT FOR DIOXIN/FURAN PARAMETER IN SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD  
KITTERY, MAINE

Parameter	PQL <sup>(1)</sup> Soil Samples (ng/kg)	MDLs <sup>(2)</sup> Soil Samples (ng/kg)	Target Quantitation Limit <sup>(3)</sup> (ng/kg)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0.2	3.9

- 1 Typical Practical Quantitation Limit (PQL); the tabulated PQL is taken from Method SW-846 8290.
- 2 MDLs are provided by Triangle Laboratory (subcontractor to Kathdin Analytical Services).
- 3 Target Quantitation Limit has been selected to be more stringent than a potential cleanup level to allow for an estimation of efficiency of contaminant reduction during the treatability study. Limit is based on USEPA Region 9 Residential Preliminary Remediation Goal (PRG).

TABLE 5-5  
LABORATORY ANALYTICAL METHOD/SOP REFERENCE TABLE  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE  
PAGE 1 OF 2

Reference Number for SOPs	Fixed-Base Laboratory Performing Analysis	Title, Revision Date and / or Number	Definitive or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrument	Modified for Project Work (Y or N)
L1	Katahdin Analytical Services	Equipment Maintenance, CA-101	NA	NA	Metals	ICP, CVAA, ICP MS, IC	N
L2	Katahdin Analytical Services	Balance Calibration, CA-102	NA	NA	All	Balance	N
L3	Katahdin Analytical Services	Calibration of Adjustable Pipettors, CA-103	NA	NA	All	Pipettors	N
L4	Katahdin Analytical Services	Use of Laboratory Water System, CA-104	NA	NA	All	NA	N
L5	Katahdin Analytical Services	Reagent, Solvent and Media Receipt, Handling, and Documentation CA-105	NA	NA	All	NA	N
L6	Katahdin Analytical Services	Standard Preparation, Documentation and Traceability, CA-106	NA	NA	All	NA	N
L10	Katahdin Analytical Services	Acid Digestion of Aqueous Samples by EPA Method 3010 for ICP Analysis of Total or Dissolved Metals CA-604	NA	NA	Metals	NA	N
L11	Katahdin Analytical Services	Acid Digestion of Solid Samples by USEPA Method 3050 for Metals Analysis by ICPACES	NA	NA	Metals	NA	N
L12	Katahdin Analytical Services	Trace Metals Analysis by ICP-AES using EPA Method 6010 CA-608	Definitive	NA	Metals (except mercury and thallium)	ICP	N
L13	Katahdin Analytical Services	Preparation and Maintenance of SOPS, QA-800	NA	NA	All	NA	N
L14	Katahdin Analytical Services	Laboratory QA: Self - Inspection System, QA-803	NA	NA	All	NA	N
L15	Katahdin Analytical Services	Document Control Procedures - QA 804	NA	NA	All	NA	N
L16	Katahdin Analytical Services	Personnel Training and Demonstration of Capability - QA-805	NA	NA	All	NA	N
L17	Katahdin Analytical Services	MDL and IDL Studies, QA-806	NA	NA	Metals	ICP, CVAA	N
L18	Katahdin Analytical Services	Method Performance / Precision and Accuracy Requirements, QA-807	NA	NA	All	NA	N
L19	Katahdin Analytical Services	Generation and Implementation of Statistical QC Limits and / or Control Charts, QA-808	NA	NA	All	NA	N
L20	Katahdin Analytical Services	Working Thermometer Verification - QA-809	NA	NA	All	Thermometers	N
L21	Katahdin Analytical Services	Communication of Client / Project Specific Information, QA-810	NA	NA	All	NA	N
L22	Katahdin Analytical Services	Subcontracting Analyses, SD-900	NA	NA	Dioxins/Misc.	NA	N
L23	Katahdin Analytical Services	Sample Container Preparation and Shipment, SD-901	NA	NA	All	NA	N
L24	Katahdin Analytical Services	Sample Receipt and Internal Control, SD-902	NA	NA	All	NA	N
L25	Katahdin Analytical Services	Sample Disposal, SD-903	NA	NA	All	NA	N
L28	Katahdin Analytical Services	Data Reduction and Validation, SD-904	NA	NA	All	NA	N
L29	Katahdin Analytical Services	Data Report Assembly, SD-905	NA	NA	All	NA	N
L30	Katahdin Analytical Services	Software Quality Assurance, SD-906	NA	NA	All	NA	N
L31	Katahdin Analytical Services	Data Back-up, Archival and Restoration, SD-913	NA	NA	All	NA	N
L32	Katahdin Analytical Services	Analysis of PCBs as Total Aroclors by Gas Chromatography/Electron Capture Detector (GC/ECD): SW-846 Method 8082 CA-329	Definitive	NA	PCBs	GC/ECD	N

TABLE 5-5

**LABORATORY ANALYTICAL METHOD/SOP REFERENCE TABLE  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE  
PAGE 2 OF 2**

Reference Number for SOPs	Fixed-Base Laboratory Performing Analysis	Title, Revision Date and / or Number	Definitive or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrument	Modified for Project Work (Y or N)
L33	Katahdin Analytical Services	Labware Cleaning, CA-100	NA	NA	All	NA	N
L36	Triangle Laboratories, Inc.	PCDDs and PCDFs by HRGC/HRMS - Method 8290	Definitive	NA	Dioxins/Furans	NA	N
L37	Triangle Laboratories, Inc.	Preventative Maintenance of Laboratory Equipment	Definitive	NA	Dioxins/Furans	NA	N
L40	Katahdin Analytical Services	Analysis of Semivolatile Organic Compounds by: SW-846 Method 8270 - Modified for Selected Ion Monitoring (SIM) CA-213	Definitive	NA	PAHs	GC/MS	N

CVAA - Cold vapor atomic absorption.

ICP - Inductively coupled plasma.

ICV - Initial calibration verification.

IDL - Instrument detection limit.

NA - Not applicable.

GC - Gas chromatograph

MS - Mass spectrometer.

PAHs - Polycyclic aromatic hydrocarbons

Definitive - An analytical method generating data of known quality.

IC - Ion Chromatograph

MDL - Method detection limit.

SOP - Standard operating procedure.

USEPA - United States Environmental Protection Agency.

ECD - Electron capture detector.

PCDD - Polychlorodibenzodioxin.

PCDF - Polychlorodibenzofuran.

HRGC - High-resolution gas chromatography.

HRMS - High-resolution mass spectrometry.

SIM - Selective Ion Monitoring

**TABLE 5-6**  
**FIXED-BASE LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION**  
**OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**  
**PAGE 1 OF 2**

Instrument	Activity	Maintenance, Testing, and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
ICP	ICP Metals	Clean torch assembly and spray chamber when discolored or when degradation in data quality, clean nebulizer, check argon, replace peristaltic pump tubing.	ICAL – At the beginning of each day or if QC does not meet criteria	NA	Recalibrate	Analyst/ Supervisor
			ICV – Immediately after every ICAL	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor
			CCV – Every 10 samples or every 2 hours and at end of run	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor
GC	PCB Analysis	Replace or cut GC column at minimum	ICAL – With minimum five-point AR1660 prior to sample analysis	ICAL – minimum five-point calibration correlation coefficient $\geq 0.990$ .	Repeat ICAL	Analyst/ Supervisor
			CCV – Every 12-hour shift prior to sample analysis and at intervals of not less than once every 20 samples and at the end of the analysis sequence.	$\pm 15\% D$	Reanalyze all samples back to last acceptable CCV.	Analyst/ Supervisor
			CCV – Daily prior to sample analysis and at intervals of not less than once every 20 samples or every 12 hours, whichever is more frequent.	$\pm 15\% D$	Reanalyze all samples after the first failing CCV.	Analyst/ Supervisor

TABLE 5-6

FIXED-BASE LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE  
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Instrument	Activity	Maintenance, Testing, and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
GC/MS	PAH Analysis	Cut column, change liner and replace septa if soils run in prior batch or as needed. Manually tune if DFTPP not in criteria.	ICAL – Instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria. Minimum five-point initial calibration for all analytes	Average RRF $\geq 0.050$ ; %RSD $\leq 30$ ; Average %RSD < 15% for all compounds.	Repeat calibration if criterion is not met	Analyst/ Supervisor
			CCV – at the beginning of each 12-hour shift immediately after DFTPP tune.	CCVs $\leq 25\%D$ ; RRF $\geq 0.050$	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	
HRGC/ HRMS	Dioxins/ Furans	Refer to TLI SOP 6.0.01 v 4	1/6 months	Refer to SOP L42	Recalibrate or reanalyze affected data	Lab Manager

Notes:

CCV Continuing calibration verification.  
amu Atomic mass units.  
PCB Polychlorinated biphenyl.  
ICAL Initial calibration.  
ICV Initial calibration verification.  
ICP Inductively coupled plasma.  
SOP Standard Operating Procedure.  
QC Quality control  
HRGC/HRMS High Resolution Gas Chromatography/Mass Spectrometry

DFTPP Decafluorotriphenylphosphine.  
RSD Relative standard deviation.  
RRF Relative response factor.  
PAH Polycyclic aromatic hydrocarbon.  
GTX-n Reference to SOP where n is a number identifying the SOP.  
GC Gas chromatograph.  
MS Mass spectrometer.  
%D percent

Refer to Table 5-5 for Method/SOP References.

**TABLE 5-7**  
**LABORATORY ANALYTICAL QC SAMPLE TABLE – PAHs AND PCBs, SOIL**  
**OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**  
**PAGE 1 OF 2**

Laboratory QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limit	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	No target analyte $\geq$ QL	Qualify data	Data validator	Accuracy/bias contamination	No target analyte $\geq$ QL
Reagent Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Storage Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Instrument Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Laboratory Duplicate	NA	NA	NA	NA	Precision	NA
Laboratory Matrix Spike	1 per 20 samples	Within laboratory- established limits	Qualify data	Data validator	Accuracy/bias	Within laboratory- established limits
Matrix Spike Duplicate	1 per 20 samples	Within laboratory- established limits	Qualify data	Data validator	Precision	Within laboratory- established limits
Laboratory Control Sample	1 per 20 samples	Within laboratory- established limits	Reanalyze after appropriate corrective action has been taken	Laboratory analyst	Accuracy/Bias	Within laboratory- established limits
Surrogate	6 per sample (PAH), 2 per each sample (PCB)	Within method- established limits	Re-extract and reanalyze, then qualify data	Laboratory analyst/Data validator	Accuracy/bias	Within method- established limits
Internal Standard	4 per sample (PAH)	+/- 50% internal standard area	Re-extract and reanalyze, then qualify data	Laboratory analyst/Data validator	Accuracy	+/- 50% internal standard area



TABLE 5-7

LABORATORY ANALYTICAL QC SAMPLE TABLE – PAHs AND PCBs, SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE  
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NA Not applicable.  
QC Quality control.  
QL Quantitation limit.  
PAHs Polycyclic aromatic hydrocarbons  
PCBs Polychlorinated biphenyls.  
SOP Standard Operating Procedure.

Note: Analytical method SOPs are referenced in Table 5-5.

TABLE 5-8

LABORATORY ANALYTICAL QC SAMPLE TABLE – METALS, SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE  
PAGE 1 OF 2

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limit	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	No target analyte $\geq$ QL	Qualify data	Data validator	Accuracy/bias contamination	No target analyte $\geq$ QL
Reagent Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Storage Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Instrument Blank	1 per 10 samples and as needed	No target analyte $\geq$ QL	Qualify data	Data validator	Accuracy/bias contamination	No target analyte $\geq$ QL
Laboratory Duplicate	1 per 20 samples	<35% RPD Soil*	Qualify data	Data validator	Precision	<35% RPD, Soil*
Laboratory Matrix Spike	1 per 20 samples	+/-25% Recovery**	Qualify data	Data validator	Accuracy/bias	+/-25% Recovery**
Matrix Spike Duplicate	NA	NA	NA	NA	Precision	NA
Laboratory Control Sample	1 per 20 samples	+/-20% Recovery	Reanalyze after appropriate corrective action has been taken	Laboratory Analyst	Bias	+/-20% Recovery
Internal Standard	Each sample	NA	NA	Laboratory analyst/Data validator	Instrument Response	NA

\* Does not apply unless sample concentration is greater than four times the adjusted instrument detection limit.

\*\* Does not apply if the spiked amount increases the sample analyte concentration by less than 25%.

TABLE 5-8

LABORATORY ANALYTICAL QC SAMPLE TABLE – METALS, SOIL  
OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE  
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NA Not applicable.  
QC Quality control.  
RPD Relative percent difference.  
QL Quantitation limit.  
SOP Standard Operating Procedure.

Note: Analytical method SOPs are referenced in Table 5-5.

## **6.0 DATA MANAGEMENT AND QUALITY ASSESSMENT PLAN**

### **6.1 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT**

This section describes how all project information will be managed, organized, and maintained for efficient use by project personnel. The information management process is outlined from the point of data generation to ultimate storage.

#### **6.1.1 Project Documentation and Records**

A summary of the OU2 site records and documentation to be generated and stored in the TtNUS project files is provided in Table 6-1. Information to be maintained in the laboratory files is also provided in Table 6-1.

#### **6.1.2 Field Analysis Data Package Deliverables**

No field screening will be performed. The only field measurements to be collected are direct monitoring readings from a Mini-Ram Particulate meter for health and safety purposes (as required by the HASP for the investigation). These readings will be recorded on field sampling sheets, test pit logs, or field logbooks.

#### **6.1.3 Fixed-Base Laboratory Data Package Deliverables**

A turnaround time of 28 days will be requested for all data collected as part of this investigation. Contract Laboratory Program (CLP)-like electronic deliverables, formatted according to the requirements stated in the laboratory subcontracts, will be provided by the laboratories.

#### **6.1.4 Data Reporting Formats**

Field data will be recorded in the field logbooks and field forms. All logbook and log sheet entries must be made in indelible ink (black pen is preferred). No erasures, liquid paper, or white out is permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, initialed, and dated. The field personnel will sign and date the logbook pages and field forms. Examples of the forms to be used in the field are presented within the SOPs in Appendix B of this work plan.

The equivalent of CLP data reporting Forms 1 through 14 required in the CLP Statement of Work (SOW) for inorganic and organic analyses will be submitted by the laboratories for the soil sample results.

#### **6.1.5      Data Handling and Management**

The data-handling procedures to be followed by the laboratories will meet the requirements in the laboratory subcontracts. All analytical and field data will be maintained in the project files. The project files will contain hard copies of the chain-of-custody forms, sample log forms, and sample location maps and documentation of QA data manipulation.

#### **6.1.6      Data Tracking and Control**

A “cradle-to-grave” sample tracking system will be used from the beginning to the end of the investigation. The sample identification system will consist of the format described in detail in Section 4.0. Before field mobilization, the FOL will coordinate with the Sample Management Coordinator (SMC) to initiate the sample tracking process. All sample numbers, requested laboratory analyses, and preservative information will be entered into a sample tracking database before each sampling event. The SMC will use the database to print sample jar labels, if necessary, before field sampling. The FOL and project chemist will review the labels for completeness of information and adherence to work plan requirements, as well as for accuracy. The SMC will also send an advanced paper copy of labels and the sample tracking database to the laboratories.

When field sampling is underway, the FOL will forward the chain-of-custody forms to the SMC via facsimile at the end of each day. The project chemist will compare the entries on the chain-of-custody forms with the sample tracking database and enter the sample date and other sample information as appropriate. The project chemist will also confirm that the chain-of-custody forms provide the information required by the work plan. This will allow for early detection of errors made in the field so that adjustments can be made while the crew is mobilized. After successful completion of all requested analyses, the laboratory will submit an electronic deliverable for every SDG. When all electronic deliverables have been received from the laboratory, queries will be run versus the pre-field effort database of sample labels and sample collection information to ensure that the laboratory performed all the requested analyses. The TtNUS PM will be notified of any discrepancies. Ideally, discrepancies will be discovered early enough so that all samples can be analyzed within the prescribed holding times.

##### **6.1.6.1      Sample Information**

Data from field measurements will be recorded directly in field notebooks or on sample logs. Reduction of field data entails the summarization and presentation of these data in tabular form. The reduction of laboratory data entails the manipulation of raw data instrument output into reportable results. Laboratory data will be verified by the analytical group supervisor and then by the laboratory's QC/Documentation Department.

Before electronic files are received from the laboratory, all sample-specific information will be entered into the data management system. The sample information file will allow the analytical results to be grouped together properly for statistical purposes. The data will be managed in one data structure.

Electronic data arriving from the laboratory will pass through the SMC to the Data Validation Manager (DVM) for database compilation and validation. The DVM will compile all of the formatted laboratory electronic deliverables into a working project database. Data that are to be validated will be printed as data packages, which include the samples as part of each SDG and the appropriate analytical fraction. The data packages will be distributed to the appropriate data validators. The data validators will enter all data qualifiers and qualifier codes into the database, print out a hard copy, and return the hard copy to the DVM. The DVM will check the data qualifiers and qualifier codes in the project database and print the final validated data for incorporation into the data validation letter. When all samples and analyses have been accounted for and validated, the DVM will forward the project database to the Management Information System (MIS) department, which will incorporate the analytical data into the relational database located on the Local Area Network (LAN) in the TtNUS Pittsburgh, Pennsylvania office.

#### **6.1.6.2 Project Data Compilation**

The analytical laboratory subcontractor(s) will generate a Portable Document Format (pdf) file of the analytical data packages and the electronic database deliverables. The electronic database will be checked against hard-copy results from the pdf file provided by the laboratory and updated as required based on data qualifier flags applied during the data validation process. The data generated under this interim monitoring program will be incorporated into the PNS database and Geographical Information System (GIS). All data, such as units of measure and chemical nomenclature, will be manipulated to maintain consistency with the project database. The project database is a relational database that ensures data structure integrity and data quality for all PNS data.

#### **6.1.6.3 Geographical Information System**

Data management systems consist of a relational database and GIS that are being used to manage environmental information pertaining to PNS. The relational database stores chemical, geological, hydrogeological, and other environmental data collected during environmental investigations. The GIS is built from the relational database and contains subsets of the larger data pool. Using the GIS, environmental data can be posted on base mapping to provide a graphical representation of the information.

Upon compilation of sample, chemical, biological, and positional data, the data will be incorporated into the PNS GIS. The GIS system can be used to generate various maps for PNS data including site location maps, sample location maps, and contaminant tag maps, as needed. ARC View is the GIS software that will be used.

## **6.2 DATA VERIFICATION AND VALIDATION**

Data verification is the process of evaluating the completeness, correctness, and contractual compliance of a data set against the method standard, SOP, or contract requirements documented in this work plan. Data validation is an analyte- and sample-specific process that extends the qualification of data beyond data verification to determine the quality of a specific data set.

The internal data verification requirements for this project include the maintenance and periodic review of field documentation (site logbooks, instrument calibration logs, chain-of-custody forms, field summary reports, and field modification records) and laboratory analytical data packages.

Data validation is a systematic review of analytical data packages with respect to sample receipt and handling, compliance with required analytical methods, data reporting and deliverables, and document control. A qualified chemist will review the analytical data packages using USEPA procedures. One hundred percent of the environmental samples collected as part of this investigation will undergo a limited validation.

After receipt of analytical results, TtNUS will perform a limited data validation according to the most recent Region 1 guidelines to ensure that the analytical results meet the DQOs. Inorganic results will be validated according to the USEPA Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (USEPA, February 1989), with consideration given to Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, July 2002). Organic results will be validated according to the USEPA Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (USEPA, December 1996), with consideration given to Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, October 1999b). All parameters will be reviewed using applicable sections of the aforementioned guidelines and the laboratory SOPs.

After the data are validated, a list of nonconformities will be generated. Nonconformities require data qualifiers, which are used to alert the data user to inaccurate or imprecise data. For situations in which several QC criteria are out of specification with regard to the limits specified in the Navy Installation Restoration Chemical Data Quality Manual (IRCDQM) (NFESC, September 1999), the data validator may make professional judgments and/or comments on the validity of the overall data package. For situations

in which the validity of an entire data package is in question, it may be necessary for the sample(s) to be reanalyzed. The reviewer will then prepare a technical memorandum (validation letter) presenting changes in the data, if necessary, and the rationale for making such changes.

The net result is a data package that has been carefully reviewed for its adherence to prescribed requirements and is suitable for its intended use. Data validation therefore plays a major role in determining the confidence with which key technical evaluations may be made.

The Tier III data validation reports for all parameters will be generated according to the requirements described in Attachment B of the USEPA – New England Data Validation Functional Guidelines for Evaluating Environmental Analyses (USEPA, December 1996). The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, Region 1 worksheets (where appropriate), and documentation to support data qualification. All data will be flagged with appropriate qualifying symbols.

The data and field records will also be reviewed by project personnel to ensure that the samples represent the intended sampling conditions and populations. Data qualified during validation will be reviewed to assess the impact of the qualifiers on the attainment of project objectives.

#### **6.2.1      Verification**

Verification includes field data verification and laboratory data verification.

##### **6.2.1.1      Field Measurement Data Verification**

The data verification process for this project includes the maintenance and periodic review of field documentation including the following:

- Field logbook
- Instrument calibration log (Mini-Ram Particulate Meter)
- Chain-of-custody form
- Field summary report
- Field modification record
- Field log sheets

Field data will be generated as a result of real-time measurements for health and safety monitoring. Field data will not be generated using a field laboratory.



If an error is made in the logbook, the error will be legibly crossed out (single-line strikeout), initialed, and dated by the field member and corrected in a space adjacent to the original (erroneous) entry. No calculations will be necessary to reduce these data for inclusion in report.

#### **6.2.1.2 Laboratory Data Verification**

Data reduction for laboratory analytical data generated via the USEPA SW-846 analytical protocol, QA requirements, and reporting procedures (for lead, antimony, PAHs, PCBs, and 2,3,7,8-TCDD) will be conducted in accordance with the most current SOW for multi-concentration inorganic and organic analyses, as identified in previous sections of this work plan.

Laboratory analytical data will be reported using standard concentration units to ensure comparability with regulatory standards and guidelines and previous analytical results. Reporting units for solid matrices for the classes of chemicals under consideration are as follows:

- Lead and antimony - mg/kg
- PAHs - µg/kg
- PCBs - µg/kg
- 2,3,7,8-TCDD - ng/kg

The results from laboratory method blanks will be considered during the course of data validation to eliminate false positive results according to the “5 times” rules specified in the National Functional Guidelines for Inorganic and Organic Data Review. The results for laboratory QC samples such as method blanks will not be presented in the database.

#### **6.2.2 Data Validation**

Validation of field measurements and laboratory analytical data is discussed in this section. Validation of field data will be limited to real-time checks in the field as data are generated, whereas laboratory analytical data will be validated in accordance with current USEPA guidance. Validation of field measurements is discussed in Section 6.2.2.1. Validation of laboratory analytical data is discussed in Section 6.2.2.2.

##### **6.2.2.1 Field Measurement Data Validation**

Field measurements will not be subjected to a formal data validation process. However, field technicians will ensure that the equipment used for field measurement is performing accurately via calibration.

#### 6.2.2.2 Analytical Laboratory Data Validation

One hundred percent of the laboratory data from chemical analyses will undergo a limited validation. Validation of analytical data will be conducted by the TtNUS Chemistry Department located in TtNUS' Pittsburgh, Pennsylvania office. Final review and approval of validation deliverables will be completed by the department's data validation coordinator. All laboratory analytical data will be subjected to validation in accordance with the most recent Region 1 validation guidelines with consideration given to the National Functional Guidelines for Inorganic and Organic Data Review to the greatest extent practicable. The components of laboratory data validation are provided in Table 6-2.

As part of the validation process, the validator will check that the laboratory has provided all of the documentation required to support the reported analytical results. If any documentation is missing from the data package, the data validator will contact the laboratory to request a resubmittal. If the laboratory fails to resubmit the requested information, the data validator will note this on the data validation cover letter. The usability of associated data will then be determined by the PM and the Navy, as discussed in Section 6.3.

Data validation will be completed to ensure that the data are of evidentiary quality. Particular emphasis will be placed on holding time compliance, equipment calibration, spike recoveries, and blank results, although all required elements of the validation process will be considered for rejection purposes.

### 6.3 DATA USABILITY AND RECONCILIATION WITH PROJECT QUALITY OBJECTIVES

#### 6.3.1 The PARCCS Parameters

The PARCCS parameters are precision, accuracy, representativeness, comparability, completeness, and sensitivity/quantitation limits. Each of these parameters is described below.

##### 6.3.1.1 Precision

The precision goal described below will be evaluated. Laboratory duplicate results, sample transport problems (if any), sample matrix problems (if any), and sample heterogeneity will be considered, as appropriate, to evaluate the overall data precision. The RPD between a MS (Sample 1) and its or MSD (Sample 2) is calculated for chemical analyses using the following formula:

$$RPD = \frac{|\text{Amount in Sample 1} - \text{Amount in Sample 2}|}{0.5 (\text{Amount in Sample 1} + \text{Amount in Sample 2})} \times 100\%$$

#### **6.3.1.2 Accuracy**

The data validator evaluates the potential for adverse impacts to the accuracy of data by reviewing laboratory blanks, LCSs, MSs, and QC check standards. The data validation process during which these evaluations are made is described in Sections 6.1 and 6.2. Calculation of accuracy is described below.

Control charts are plotted by the laboratory for each target analyte and are kept on matrix- and analyte-specific bases. The percent recovery (%R) for a spiked sample is calculated using the following formula:

$$\%R = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \times 100\%$$

LCSs and surrogate spikes are also analyzed to assess accuracy. The %R calculation for LCSs and surrogate spikes is as follows:

$$\%R = \frac{\text{Experimental Concentration}}{\text{Certified or Known Concentration}} \times 100\%$$

During data validation, any data not meeting accuracy specifications are identified to the data user through the use of data qualifiers. The laboratory blanks provide indications of the potential contamination of samples during analysis. Laboratory blank will be evaluated for its impact on the analytical processes, as appropriate. Laboratory control standards and check standards indicate whether analyte quantitation is accurate and whether the analytical system was capable of generating results within the project accuracy specifications. MS recoveries indicate and will be evaluated to assess the impact of specific sample matrices on the accuracy of project data.

#### **6.3.1.3 Sample Representativeness**

Sampling methods and procedures were selected during project planning to provide data representing environmental media at OU2 with bias as discussed in Section 2.0. Whether biases were intended and how bias was used to an advantage are described in Section 2.0. To evaluate representativeness of the OU2 data, the actual samples collected will be compared to the samples that were intended to be collected. Furthermore, the results of data verification and validation will be reviewed to ensure that data have met project specifications for precision and accuracy. The degree to which project specifications have been met will provide a qualitative assessment of the representativeness of the OU2 data.

#### **6.3.1.4 Comparability**

Compliance with the selected methods of sample analyses will produce data of suitable comparability with past and future investigations, as well as within this investigation. Therefore, compliance with the selected analytical methods will be evaluated by reviewing data validation reports generated during data verification and validation. Sample collection is from test pits as composites, and therefore it is not expected to be comparable to sampling methods from previous investigations.

#### **6.3.1.5 Completeness**

Completeness will be computed in accordance with the following equation:

$$\% \text{ Completeness} = \frac{\text{Number of valid measurements}}{\text{Number of measurements planned}} \times 100\%$$

Completeness is a measure of the amount of valid data obtained from the measurement program compared to the total amount collected. Valid data are defined as data that have not been rejected or considered unusable based on validation or data review. Percent completeness is expressed as the ratio of the number of validated data points to the number of planned data points. For relatively clean, homogeneous matrices, 100 percent completeness is expected. However, as matrix complexity and heterogeneity increase, completeness may decrease. Where analysis is precluded or where DQOs are compromised, the ability to achieve project objectives will be evaluated. Whether any particular sample is critical (absolutely necessary for the attainment of project objectives) to the investigation will be evaluated in terms of the sample location, the parameter in question, the intended data use, and the impact on the project decision-making ability caused by the deficiency.

Critical data points may not be identified until all of the analytical results are evaluated. If in the evaluation of results it becomes apparent that data for a specific medium are of insufficient quality (minimum of 95 percent completeness), either with respect to the number of samples or individual analyses, resampling to replace the deficient data points may be necessary. The Navy and TtNUS will determine whether resampling is necessary depending on what data are missing and how critical it is to evaluate the treatability study.

#### **6.3.1.6 Sensitivity and Quantitation Limits**

The quantitation and detection limits required to ensure attainment of project action levels specified in Section 2.0 will be evaluated. The sample quantitation limits, the low point instrument calibration standard, matrix interferences, and sample dilutions will be evaluated to assess whether the sensitivity

goals were met. Sensitivity assessment will be less of a concern during the initial characterization phase (because high concentrations are targeted), however as the project proceeds and soil concentrations are expected to decrease, sensitivity/quantitation limits will become more important. Nonetheless, any significant deviations will be indicated during the data validation and overall data review processes.

### **6.3.2      Data Quality Assessment**

After data validation and an overall review of data quality indicators, the data will be reconciled with DQOs to determine whether sufficient data of acceptable quality are available for decision making. A series of inspections and statistical analyses will be performed to estimate several of the data set characteristics. The statistical evaluations will include simple summary statistics for target analytes such as maximum concentration, minimum concentration, number of samples exhibiting no detectable analyte, the number of samples exhibiting detectable analytes, and the proportion of samples with detectable and undetectable analytes. The data will be presented in a tabular format. These inspections and statistical analyses will be designed to:

- Identify deviations, if any, from the field sampling SOPs.
- Identify deviations, if any, from the laboratory analytical SOPs.
- Identify deviations, if any, from the work plan.
- Identify deviations, if any, from the data validation process.
- Evaluate effects of the above-listed deviations from planned procedures and processes on the interpretation and utility of the data (via statistics, as applicable).
- Identify elevated detection limits and explain their impacts on the attainment of project objectives.
- Identify unusable data (i.e., data qualified as "R").
- Evaluate project assumptions.

After all data evaluations are completed, any limitations on the use of data will be known and the limitations will be considered during decision making. If necessary, investigation objectives may be revised in anticipation of additional data collection in order to meet project objectives for the site.

TABLE 6-1

**SAMPLING AND ANALYTICAL PROGRAM DOCUMENTATION AND RECORDS  
OU2 SOIL SAMPLING AND TREATABILITY STUDY  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

<b>Sample Collection Records</b>	<b>Fixed-Base Laboratory Records</b>	<b>Data Assessment Records</b>	<b>Other</b>
Field logbooks	Sample receipt, custody and tracking records	Audit report and quality notices	Health and Safety Plan
Soil sample log sheet	Standards traceability logs	Data validation report	All versions of project reports
Test pit logs	Equipment calibration logs		
Chain-of-custody records	Sample prep logs		
Telephone logs	Sample analysis logs		
Field instrument calibration logs	Equipment maintenance and testing logs		
	Corrective action forms		
	Data results forms		
	Reported results for standards, QC checks, and QC samples		
	Instrument printouts for samples and standards		
	Data verification check list		
	Sample disposal records		
	Telephone logs		

TABLE 6-2

**DATA VALIDATION SUMMARY TABLE / MODIFICATION  
OU2 SOIL SAMPLING AND TREATABILITY STUDY  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Medium/ Matrix	Analytical Parameter	Concentration Level	Validation Criteria	Validation Criteria Modified	Data Validation Tier Level Used	Modified Tier Level Used	Data Validator (Name, Title, and Organizational Affiliation)	Responsibility for Data Validation (Name, Title, and Organizational Affiliation)
Soil	Metals	Low/Medium	USEPA Region 1 Functional Guidelines for Evaluating Inorganic Analyses, February 1989; as relevant, National Functional Guidelines for Inorganic Review, July 2002, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual. (September, 1999) as relevant.	N	Tier II	N	TBD <sup>(1)</sup>	Data Validation Coordinator
Soil	PAHs, PCBs, Dioxins	Low/Medium	USEPA Region 1 Functional Guidelines for Evaluating Organic Analyses, December 1996, as relevant; National Functional Guidelines for Organic Review, October 1999b, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual, (September, 1999) as relevant.	N	Tier II	N	TBD <sup>(1)</sup>	Data Validation Coordinator

1 Data validator will be determined when the pdf data deliverables arrive from the laboratory.

TBD To be determined.  
NFESC Naval Facilities Engineering Service Center.

PAHs Polycyclic aromatic hydrocarbons.  
PCBs Polychlorinated biphenyls.

## REFERENCES

FWENC, June 2001. Final Action Memorandum for Site 6, Defense Reutilization and Marketing Office (DRMO) Shoreline Stabilization for Portsmouth Naval Shipyard. Foster Wheeler Environmental Corporation, Langhorne, PA.

Loureiro Engineering Associates, June 1986. Final Confirmation Study Report on Hazardous Waste Sites at Portsmouth Naval Shipyard, Kittery, Maine. Loureiro Engineering Associates.

McLaren/Hart, July 1992. Draft RCRA Facility Investigation Report, Portsmouth Naval Shipyard, Kittery, Maine. McLaren/Hart Environmental Engineering Corporation, Albany, NY. Includes as an appendix, Revised Ambient Air Quality Monitoring Report. McLaren/Hart Environmental Engineering Corporation, Albany, NY, April 1992.

McLaren/Hart, April 1993. Interim Corrective Measures at the Defense Reutilization and Marketing Office, McLaren/Hart Environmental Engineering Corporation, Lester, PA.

NFESC, September 1999. Navy Installation Restoration Chemical Data Quality Manual (IRCDQM), Naval Facilities Engineering Services Command, September.

TtNUS (Tetra Tech NUS, Inc.), March 2000. Field Investigation Report, Site 10 (Building 238) and Site 29 (Teepee Incinerator), for Portsmouth Naval Shipyard, Kittery, Maine, TtNUS, King of Prussia, PA.

TtNUS (Tetra Tech NUS, Inc.), November 2000. Revised OU2 Risk Assessment, Portsmouth Naval Shipyard, Kittery, Maine. TtNUS, King of Prussia, PA.

USEPA, February 1989. Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, June 1988, as modified in February 1989.

USEPA, September 1991. Guide for Conducting Treatability Studies under CERCLA: Soil Washing, Interim Guidance, EPA/540/2-91/020A.

USEPA, December 1996. USEPA New England Data Validation Functional Guidelines for Evaluating Organic Analyses, December 1996.



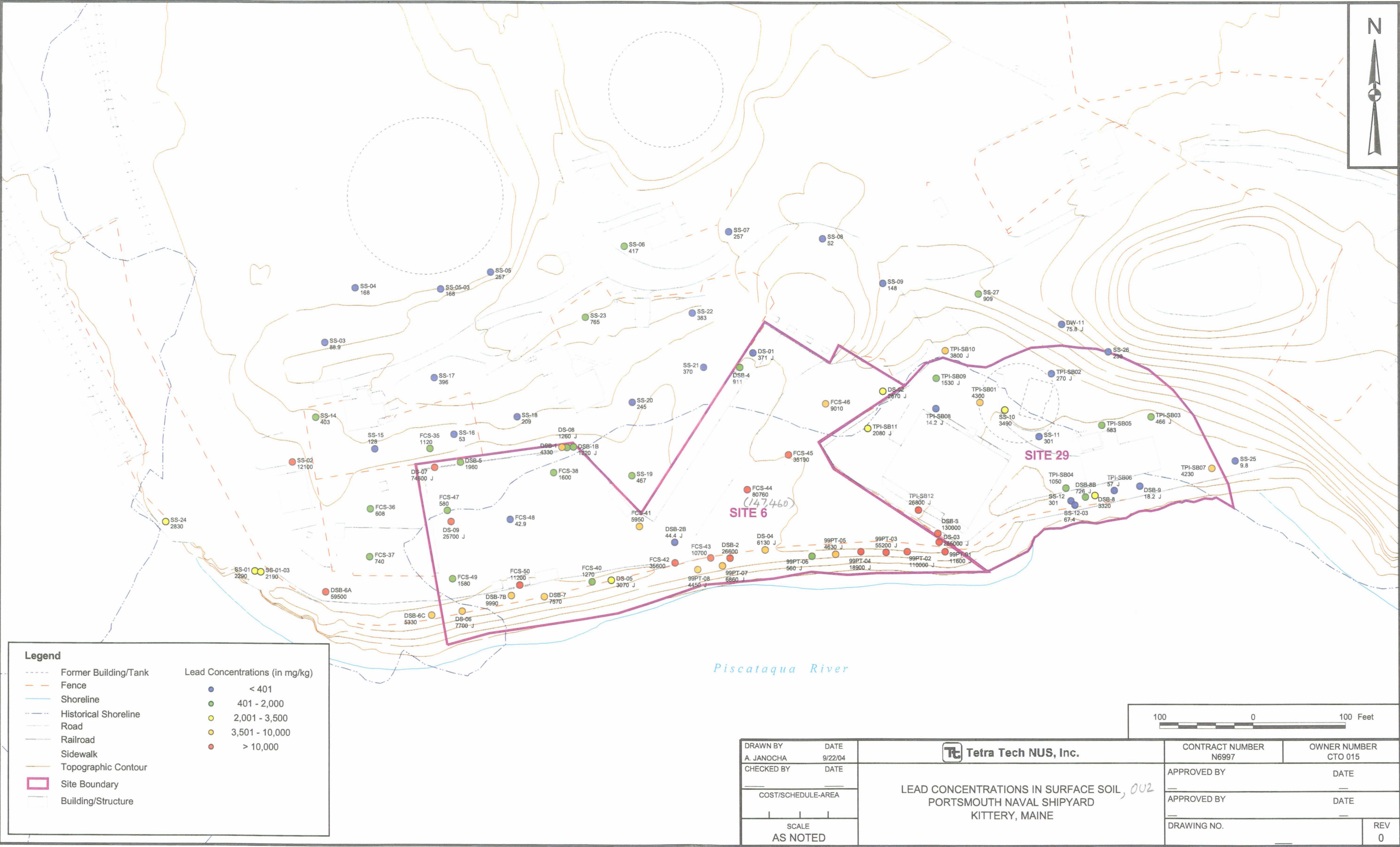
USEPA, October 1999a. USEPA New England Compendium of Quality Assurance Project Plan Requirements and Guidance, Final. USEPA-New England Region 1 Quality Assurance Unit Staff Office of Environmental Measurement and Evaluation.

USEPA, October 1999b. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999.

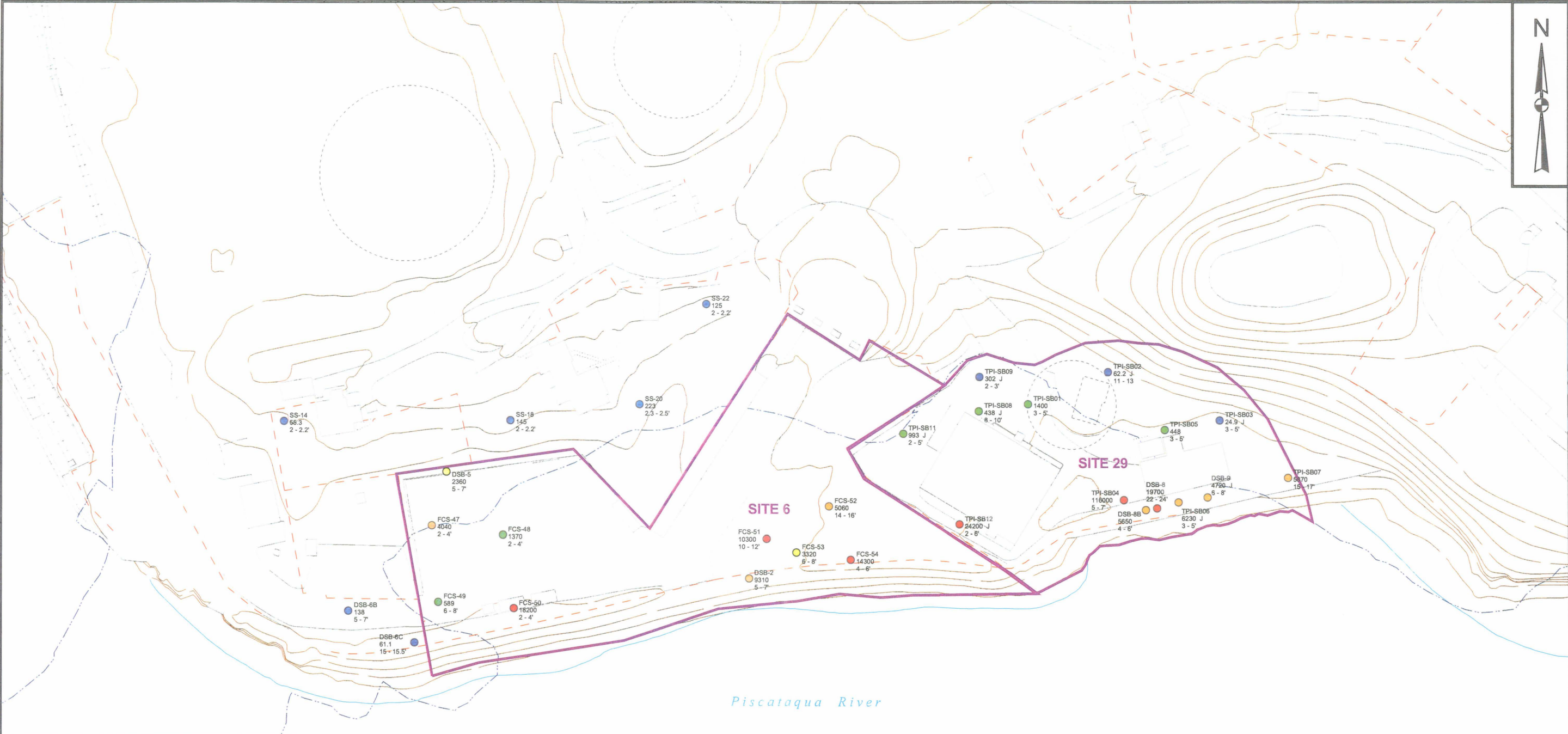
USEPA, August 2000. Guidance for the Data Quality Objectives Process, EPA QA/G-4, USEPA, Office of Information, Washington, D.C., 20460, EPA/600/R-96/055, August 2000.

USEPA, July 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, July 2002.

**APPENDIX A**  
**DATA DISTRIBUTION FOR COCs**





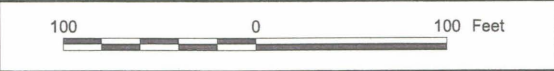



**Legend**

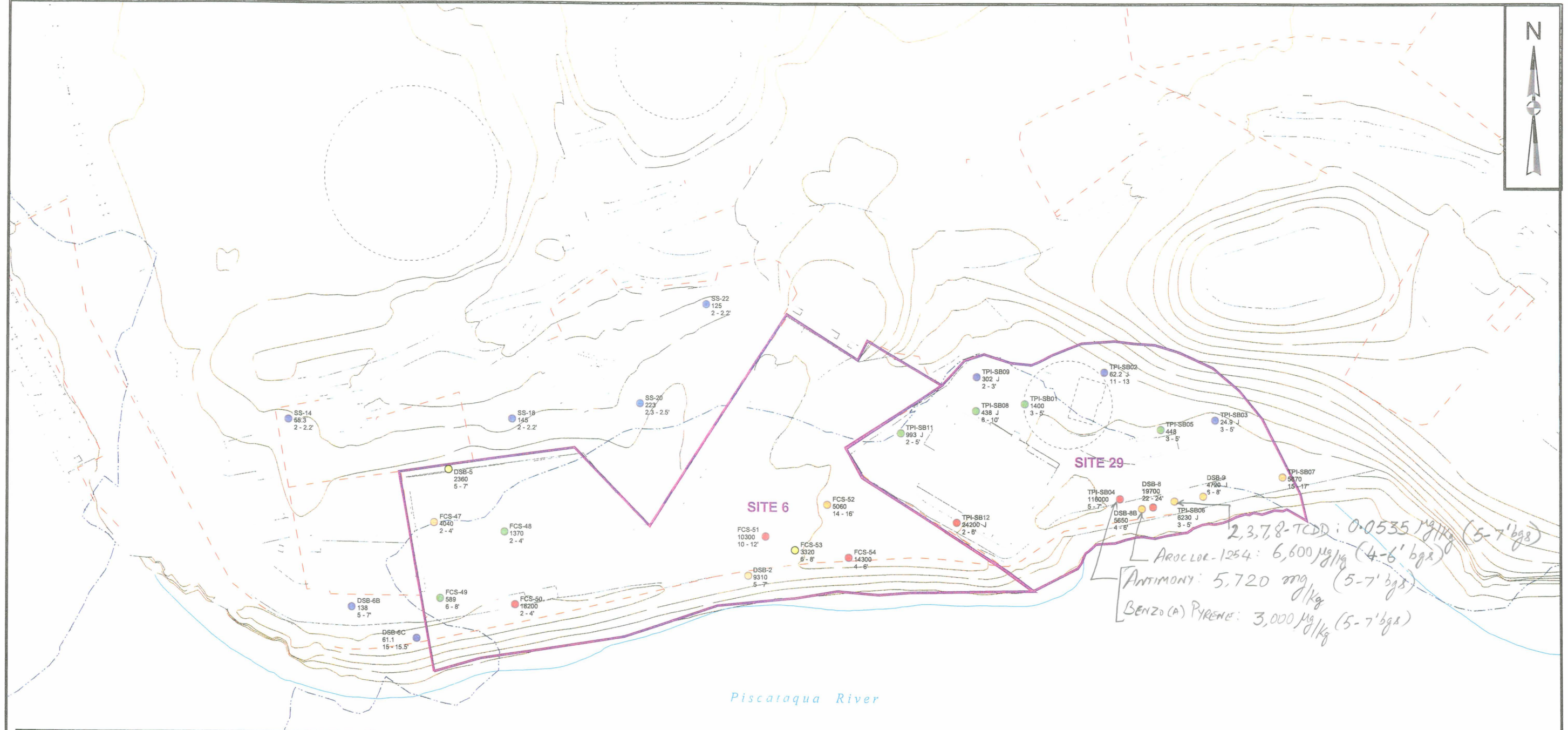
- Former Building/Tank
- - - Fence
- Shoreline
- - - Historical Shoreline
- Road
- Railroad
- Sidewalk
- Topographic Contour
- Site Boundary
- Building/Structure

**Lead Concentrations (in mg/kg)**

- < 401
- 401 - 2,000
- 2,001 - 3,500
- 3,501 - 10,000
- > 10,000



DRAWN BY A. JANOCHA	DATE 9/22/04	 Tetra Tech NUS, Inc.	CONTRACT NUMBER N6997		OWNER NUMBER CTO 015	
CHECKED BY _____	DATE _____		APPROVED BY _____		DATE _____	
COST/SCHEDULE-AREA 			APPROVED BY _____		DATE _____	
SCALE AS NOTED			DRAWING NO. _____			
LEAD CONCENTRATIONS IN SUBSURFACE SOIL, 002 PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE						



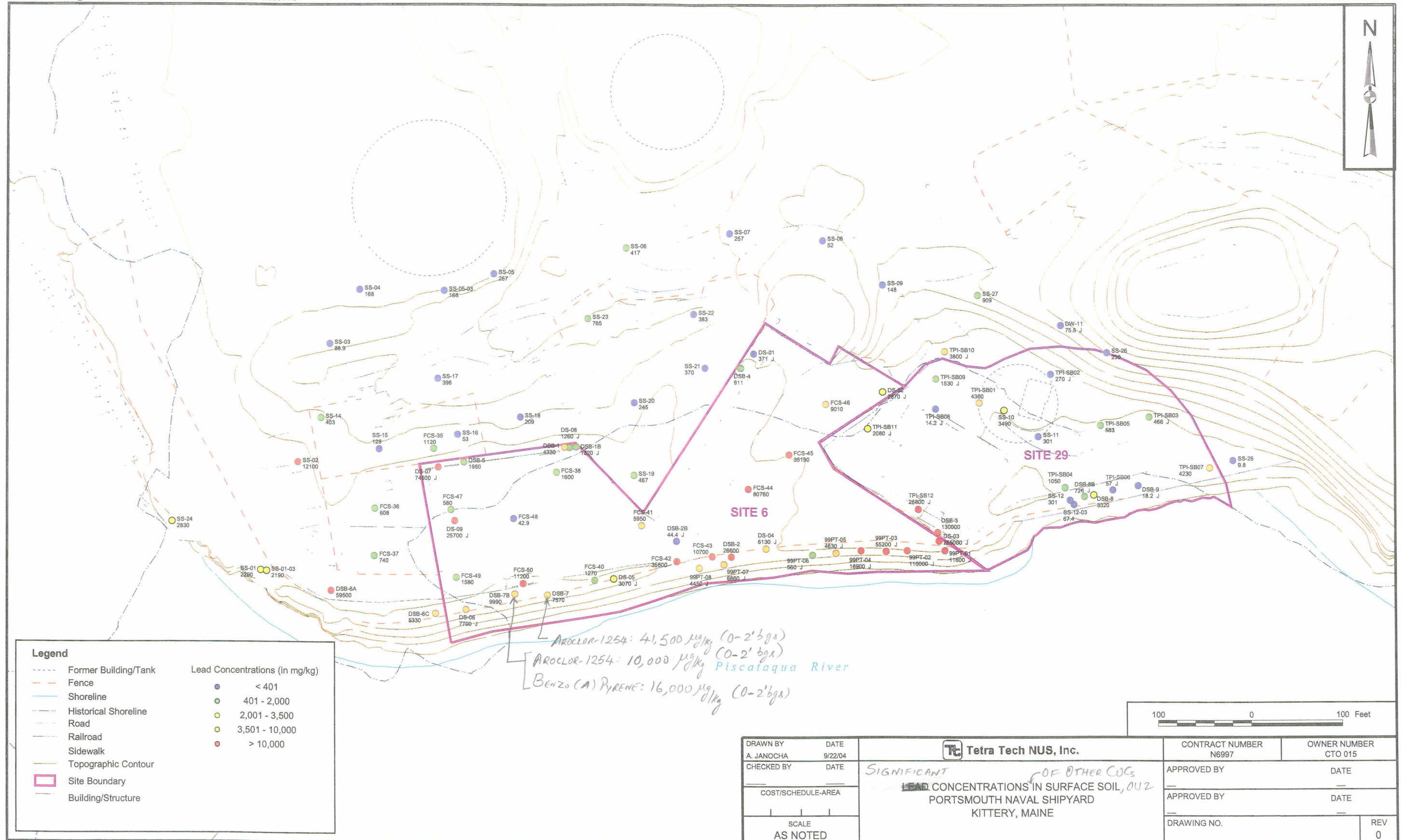
# Legend

-----	Former Building/Tank	Lead Concentrations (in mg/kg)
---	Fence	● < 401
---	Shoreline	● 401 - 2,000
---	Historical Shoreline	● 2,001 - 3,500
---	Road	● 3,501 - 10,000
---	Railroad	● > 10,000
---	Sidewalk	
---	Topographic Contour	
---	Site Boundary	
---	Building/Structure	

100 0 100 Feet

DRAWN BY A. JANOSHA	DATE 9/22/04	Tetra Tech NUS, Inc.		CONTRACT NUMBER N6997	OWNER NUMBER CTO 015
CHECKED BY	DATE	SIGNIFICANT LEAD CONCENTRATIONS IN SUBSURFACE SOIL, OUT OF OTHER COCs		APPROVED BY	DATE
COST/SCHEDULE-AREA		PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE		APPROVED BY	DATE
SCALE AS NOTED				DRAWING NO.	REV 0





**APPENDIX B**  
**STANDARD OPERATING PROCEDURES FOR SAMPLE COLLECTION**

**SUMMARY OF STANDARD OPERATING PROCEDURES  
OU2 SOIL SAMPLING AND ANALYSIS WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

S1 SA-1.3 SOIL SAMPLING  
~~S2 SA-2.5 DIRECT PUSH TECHNOLOGY~~ S2 *ET-04 SAMPLE NOMENCLATURE*  
S3 SA-6.1 NON-RADIOLOGICAL SAMPLE HANDLING  
S4 SA-6.3 FIELD DOCUMENTATION  
S5 SA-7.1 DECONTAMINATION OF FIELD EQUIPMENT AND WASTE HANDLING  
S6 GH-1.5 BOREHOLE AND SAMPLE LOGGING





**TETRA TECH NUS, INC.**

# STANDARD OPERATING PROCEDURES

Number

SA-1.3

Page

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Effective Date

09/03

Revision

7

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Subject

SOIL SAMPLING

Approved

D. Senovich

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## 1.0 PURPOSE

This procedure discusses the methods used to collect surface, near surface, and subsurface soil samples. Additionally, it describes the method for sampling of test pits and trenches to determine subsurface soil and rock conditions, and recover small-volume or bulk samples.

## 2.0 SCOPE

This procedure is applicable to the collection of surface, near surface and subsurface soils for laboratory testing, which are exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites.

## 3.0 GLOSSARY

Composite Sample - A composite sample exists as a combination of more than one sample at various locations and/or depths and times, which is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples are not to be collected for volatile organics analysis.

Grab Sample - One sample collected at one location and at one specific time.

Non-Volatile Sample - A non-volatile sample includes all other chemical parameters (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Hand Auger - A sampling device used to extract soil from the ground in a relatively undisturbed form.

Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2-inch OD to 3-1/2 inch OD. The larger sizes are commonly used when a larger volume of sample material is required.

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher excavator, or bulldozer).

Confined Space - As stipulated in 29 CFR 1910.146, a confined space means a space that: 1) is large enough and so configured that an employee can bodily enter and perform assigned work; 2) has limited or restricted means for entry or exit (for example tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and 3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

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#### 4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for determining sampling objectives, as well as, the field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches, and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring and excavation activities, and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - The FOL is responsible for finalizing the location of surface, near surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits and trenches, and for adherence to OSHA regulations during these operations.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of soil samples and the completion of all required paperwork (i.e., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms).

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

#### 5.0 PROCEDURES

##### 5.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they have migrated into the water table, and can establish the amount of contamination sorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during the sampling operations, particularly noting the location, depth, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. As a result, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. Often this information on soil properties can be obtained from published soil surveys available through the U.S. Geological Surveys and other government or farm agencies. It is the

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intent of this procedure to present the most commonly employed soil sampling methods used at hazardous waste sites.

## 5.2 Soil Sample Collection

### 5.2.1 Procedure for Collecting Soil Samples for Volatile Organic Compounds

The above described traditional sampling techniques, used for the collection of soil samples for volatile organic analysis, have recently been evaluated by the scientific community and determined to be ineffective in producing accurate results (biased low) due to the loss of volatile organics in the sampling stages and microbial degradation of aromatic volatiles. One of the newly adopted sampling procedures for collecting soil samples includes the field preservation of samples with methanol or sodium bisulfate to minimize volatilization and biodegradation. These preservation methods may be performed either in the field or laboratory, depending on the sampling methodology employed.

Soil samples to be preserved by the laboratory are currently being performed using method SW-846, 5035. Laboratories are currently performing low level analyses (sodium bisulfate preservation) and high level analyses (methanol preservation) depending on the end users needs.

It should be noted that a major disadvantage of the methanol preservation method is that the laboratory reporting limits will be higher than conventional testing. The reporting levels using the new method for most analytes are 0.5 µg/g for GC/MS and 0.05 µg/g for GC methods.

The alternative preservation method for collecting soil samples is with sodium bisulfate. This method is more complex to perform in the field and therefore is not preferred for field crews. It should also be noted that currently, not all laboratories have the capabilities to perform this analysis. The advantage to this method is that the reporting limits ( 0.001 µg/g for GC/PID or GC/ELCD, or 0.010 for GC/MS) are lower than those described above.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

#### 5.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organics that are to be preserved at the laboratory will be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample will be obtained using a reusable sampling handle provided with the EnCore™ sampler. The sample is collected by pushing the EnCore™ sampler directly into the soil, ensuring that the sampler is packed tight with soil, leaving zero headspace. Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore™ sampler shipment by the manufacturer.

Once the sample is collected, it should be placed on ice immediately and shipped to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

If the lower detection limits are necessary, an option would be to collect several EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

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#### 5.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) method and medium-level (methanol preservation) method.

##### Methanol Preservation (Medium Level):

Soil samples to be preserved in the field with methanol will utilize 40-60 mL glass vials with septum lids. Each sample bottle will be filled with 25 mL of demonstrated analyte-free purge and trap grade methanol. Bottles may be prespiked with methanol in the laboratory or prepared in the field.

Soil will be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol preserved sample bottle. Calibration of the scale should be performed prior to use and intermittently throughout the day according to the manufacturers requirements.

The sample should be collected by pulling the plunger back and inserting the syringe into the soil to be sampled. The top several inches of soil should be removed before collecting the sample. Approximately 10 grams  $\pm$  2g (8-12 grams) of soil should be collected. The sample should be weighed and adjusted until obtaining the required amount of sample. The sample weight should be recorded to the nearest 0.01 gram in the field logbook and/or sample log sheet. The soil should then be extruded into the methanol preserved sample bottle taking care not to contact the sample container with the syringe. The threads of the bottle and cap must be free of soil particles.

After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

##### Sodium Bisulfate Preservation (Low Level):

Samples to be preserved using the sodium bisulfate method are to be prepared as follows:

Add 1 gram of sodium bisulfate to 5 mL of laboratory grade deionized water in a 40-60 mL glass vial with septum lid. Bottles may be prespiked in the laboratory or prepared in the field. The soil sample should be collected in a manner as described above and added to the sample container. The sample should be weighed to the nearest 0.01 gram as described above and recorded in the field logbook or sample log sheet.

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soils containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode.

When preparing samples using the sodium bisulfate preservation method, duplicate samples must be collected using the methanol preservation method on a one for one sample basis. The reason for this is because it is necessary for the laboratory to perform both the low level and medium level analyses. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

If the lower detection limits are necessary, an option to field preserving with sodium bisulfate would be to collect 3 EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

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## 5.2.2 Procedure for Collecting Non-Volatile Soil Samples

Non-volatile soil samples may be collected as either grab or composite samples. The non-volatile soil sample is thoroughly mixed in a stainless steel or disposable, inert plastic tray, using a stainless steel trowel or other approved tool, then transferred into the appropriate sample container(s). Head space is permitted in a non-volatile soil sample container to allow for sample expansion.

## 5.2.3 Procedure for Collecting Undisturbed Soil Samples (ASTM D1587-83)

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) will be employed. The following method will be used:

1. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.
2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Use of any side-discharge bits is permitted.
3. A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.
4. To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they're more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
5. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Clean filler must be placed in voids at either end of the tube prior to sealing with wax. Place plastic caps on the ends of the sample tube, tape the caps in place, and dip the ends in wax.
6. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label. Mark the "up" direction on the side of the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody (see SOP SA-6.3) and other required forms (including Attachment A of this SOP). Do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

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Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs, and therefore their use shall be weighed against the need for acquiring an undisturbed sample.

### 5.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples (most commonly collected to a depth of 6 inches) for subsequent analysis is by use of a stainless steel trowel. Surface soils are considered 0-12 inches bgs.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Real-time air monitoring instrument (e.g., PID, FID, etc.).
- Latex gloves.
- Required Personal Protective Equipment (PPE).
- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP).
- Required decontamination equipment.
- Required sample container(s).
- Wooden stakes or pin flags.
- Sealable polyethylene bags (i.e., Ziploc® baggies).
- Heavy duty cooler.
- Ice.
- Chain-of-custody records and custody seals.

When acquiring surface soil samples, the following procedure shall be used:

1. Carefully remove vegetation, roots, twigs, litter, etc., to expose an adequate soil surface area to accommodate sample volume requirements.
2. Using a decontaminated stainless steel trowel, follow the procedure cited in Section 5.2.1 for collecting a volatile soil sample. Surface soil samples for volatile organic analysis should be collected from 6-12 inches bgs only.
3. Thoroughly mix (in-situ) a sufficient amount of soil to fill the remaining sample containers and transfer the sample into those containers utilizing the same stainless steel trowel employed above. Cap and securely tighten all sample containers.
4. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.
5. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

### 5.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6-18 inches) can be accomplished with tools such as shovels and stainless steel or pre-cleaned disposable trowels.

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The following equipment is necessary to collect near surface soil samples:

- Clean shovel.
- The equipment listed under Section 5.3 of this procedure.
- Hand auger.

To obtain near-surface soil samples, the following protocol shall be observed:

1. With a clean shovel, make a series of vertical cuts to the depth required in the soil to form a square approximately 1 foot by 1 foot.
2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.
3. Follow steps 2 through 5 listed under Section 5.3 of this procedure.

#### **5.5 Subsurface Soil Sampling With a Hand Auger**

A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e., cylinders 6-1/2" long, and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), and a cross handle. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then withdrawn. In turn, the larger diameter bit is replaced with a smaller diameter bit, lowered down the hole, and slowly turned into the soil at the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes).
- Stainless steel mixing bowls.
- The equipment listed under Section 5.3 of this procedure.

To obtain soil samples using a hand auger, the following procedure shall be followed:

1. Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook, boring log, and/or on standardized data sheets) any changes in the color, texture or odor of the soil.
4. After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.
5. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is commonly smaller in diameter than the bucket bit employed to initiate the borehole.



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6. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
7. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
8. Discard the top of the core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the sample material.
9. Fill volatile sample container(s), using a properly decontaminated stainless steel trowel, with sample material directly from the bucket bit. Refer to Section 5.2.1 of this procedure.
10. Utilizing the above trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
11. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

#### **5.6      Subsurface Soil Sampling With a Split-Barrel Sampler (ASTM D1586-84)**

Split-barrel (split-spoon) samplers consist of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-lb. or larger casing driver.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (O.D. 2 inches, I.D. 1-3/8 inches, either 20 inches or 26 inches long); Larger O.D. samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-lb. weight, driving head and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed under Section 5.3 of this procedure.

The following steps shall be followed to obtain split-barrel samples:

1. Remove the drive head and nosepiece, and open the sampler to reveal the soil sample. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.). Carefully separate the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.
2. Collect the volatile sample from the center of the core where elevated readings occurred. If no elevated readings were encountered the sample material should still be collected from the core's

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center (this area represents the least disturbed area with minimal atmospheric contact). Refer to Section 5.2.1 of this procedure.

3. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl. Thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
4. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

#### **5.7      Subsurface Sol Sampling Using Direct Push Technology**

Subsurface soil samples can be collected to depths of 40+ feet using direct push technology (DPT). DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

#### **5.8      Excavation and Sampling of Test Pits and Trenches**

##### **5.8.1      Applicability**

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise which control the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is still required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. Any entry may constitute a Confined Space and must be done in conformance with all applicable regulations. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146.

Excavations are generally not practical where a depth of more than about 15 feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

##### **5.8.2      Test Pit and Trench Excavation**

These procedures describe the methods for excavating and logging test pits and trenches excavated to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

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Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration.
- The space required for efficient excavation.
- The chemicals of concern.
- The economics and efficiency of available equipment.

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, gives a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area, and spoils pile will be predicated based on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

As mentioned previously, no personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is still required, Occupational Safety and Health Administration (OSHA) requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry). It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example, samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

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### **5.8.3 Sampling in Test Pits and Trenches**

#### **5.8.3.1 General**

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made as presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable Health and Safety and OSHA requirements have been met.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information would include soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples, which can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

#### **5.8.3.2 Sampling Equipment**

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottleware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps and right angle adapter for conduit (see Attachment D).

#### **5.8.3.3 Sampling Methods**

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.8.3.4.

- Excavate trench or pit in several depth increments. After each increment, the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. (Monitoring of volatiles by the SSO will also be used to evaluate the need for sampling.) Practical depth increments range from 2 to 4 feet.

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- The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:
  - Any fluid phase or groundwater seepage is encountered in the test pit.
  - Any drums, other potential waste containers, obstructions or utility lines are encountered.
  - Distinct changes of material are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending upon the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Remove loose material to the greatest extent possible with backhoe.
- Secure walls of pit if necessary. (There is seldom any need to enter a pit or trench which would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)
- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material once it has been deposited on the ground. The sampler or Field Operations Leader directs the backhoe operator to remove material from the selected depth or location within the test pit/trench. The bucket is brought to the surface and moved away from the pit. The sampler and/or SSO then approaches the bucket and monitors its contents with a photoionization or flame ionization detector. The sample is collected from the center of the bucket or pile and placed in sample containers using a decontaminated stainless steel trowel or disposable spatula.
- If a composite sample is desired, several depths or locations within the pit/trench are selected and a bucket is filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.
- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the side wall or bottom of the pit. The face of the pit/trench shall first be scraped (using a long-handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample shall then be collected directly into the sample jar, by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar is then capped, removed from the assembly, and packaged for shipment.
- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

#### 5.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soils or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

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- There is no practical alternative means of obtaining such data.
- The Site Safety Officer and Competent Person determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- A Company-designated Competent Person determines that the pit/trench is stable or is made stable (by grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements must be strictly observed.

If these conditions are satisfied, one person will enter the pit/trench. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit. He/she will be affixed to a safety rope and continuously monitored while in the pit.

A second individual will be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon. As an added precaution, it is advisable to keep the backhoe bucket in the test pit when personnel are working below grade. Such personnel can either stand in or near the bucket while performing sample operations. In the event of a cave-in they can either be lifted clear in the bucket, or at least climb up on the backhoe arm to reach safety.

#### 5.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 5.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.
- Suitable driving (i.e., a sledge hammer) or pushing (i.e., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soils in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification, while larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe,

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rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 5.8.3.4 of this procedure must be followed. The open tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A sledge hammer or the backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry of the test pit, the requirements in Section 5.8.3.4 of this procedure must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP SA-6.3 and SA-6.1.

#### **5.8.4 Backfilling of Trenches and Test Pits**

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

#### **5.9 Records**

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining GPS coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of boring and excavation.

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- Approximate surface elevation.
- Total depth of boring and excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

## 6.0 REFERENCES

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

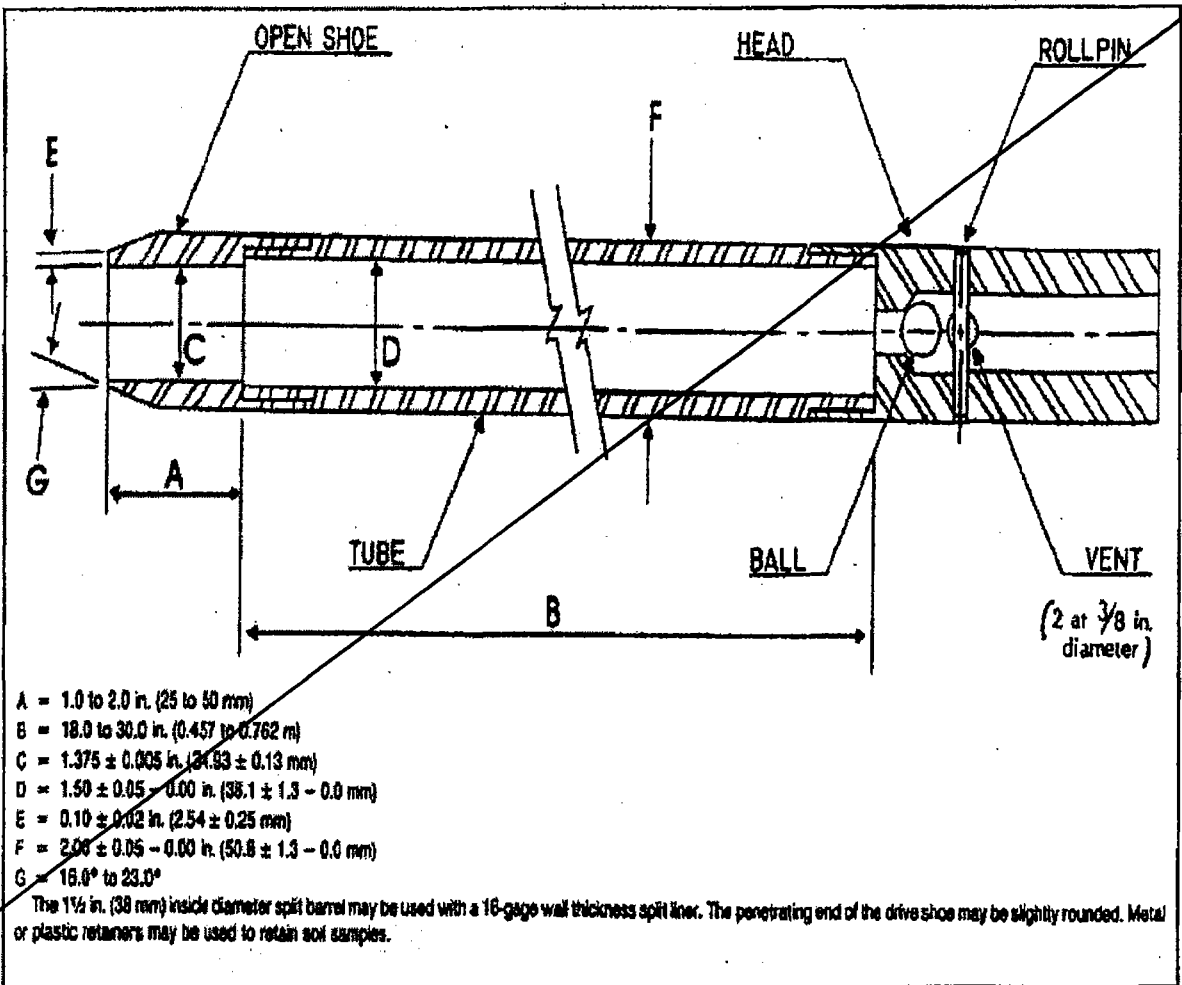
OSHA, Confined Space Entry 29 CFR 1910.146.





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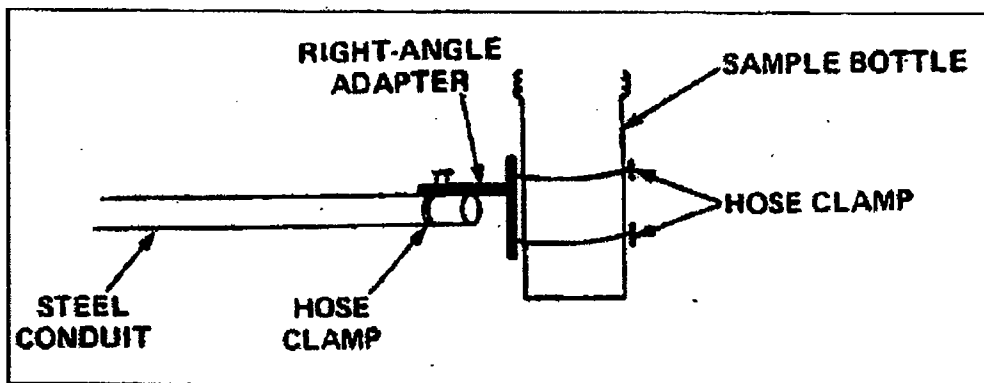
# ATTACHMENT B SPLIT-SPOON SAMPLER





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**ATTACHMENT D  
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING**





**TETRA TECH NUS, INC.**

# STANDARD OPERATING PROCEDURES

Number

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Tetra Tech NUS, Inc.

Prepared

Risk Assessment Department

Subject

SAMPLE NOMENCLATURE

Approved

D. Senovich

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## 1.0 PURPOSE

The purpose of this document is to specify a consistent sample nomenclature system that will facilitate subsequent data management in a cost-effective manner. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by matrix.
- Sorting of data by depth.
- Maintenance of consistency (field, laboratory, and data base sample numbers).
- Accommodation of all project-specific requirements.
- Accommodation of laboratory sample number length constraints (maximum of 20 characters).

## 2.0 SCOPE

The methods described in this procedure shall be used consistently for all projects requiring electronic data.

## 3.0 GLOSSARY

None.

## 4.0 RESPONSIBILITIES

**Program Manager** - It shall be the responsibility of the Program Manager (or designee) to inform contract-specific Project Managers of the existence and requirements of this Standard Operating Procedure.

**Project Manager** - It shall be the responsibility of the Project Manager to determine the applicability of this Standard Operating Procedure based on: (1) program-specific requirements, and (2) project size and objectives. It shall be the responsibility of the Project Manager (or designee) to ensure that the sample nomenclature is thoroughly specified in the relevant project planning document (e.g., sampling and analysis plan) and is consistent with this Standard Operating Procedure if relevant. It shall be the responsibility of the project manager to ensure that the Field Operations Leader is familiar with the sample nomenclature system.

**Field Operations Leader** - It shall be the responsibility of the Field Operations Leader to ensure that all field technicians or sampling personnel are thoroughly familiar with this Standard Operating Procedure and the project-specific sample nomenclature system. It shall be the responsibility of the Field Operations Leader to ensure that the sample nomenclature system is used during all project-specific sampling efforts.

## 5.0 PROCEDURES

### 5.1 Introduction

The sample identification (ID) system can consist of as few as 8 but not more than 20 distinct alphanumeric characters. The sample ID will be provided to the laboratory on the sample labels and chain-of-custody forms. The basic sample ID provided to the lab has three segments and shall be as follows where "A" indicates "alpha," and "N" indicates "numeric":

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters
Site Identifier	Sample Type	Sample Location

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Additional segments may be added as needed. For example:

(1) Soil and Sediment Sample ID

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters	NNNN 4-Characters
Site Identifier	Sample Type	Sample Location	Sample Depth

(2) Aqueous (groundwater or surface water) Sample ID

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters	NN 2-Characters	-A
Site Identifier	Sample type	Sample Location	Round Number	Filtered Sample only

(3) Biota Sample ID

A or N 3- or 4-Characters	AAA 2- or 3-Characters	A or N 3- to 6-Characters	AA 2-Characters	NNN 3-Characters
Site Identifier	Sample Type	Sample Location	Species Identifier	Sample Group Number

## 5.2 Sample Identification Field Requirements

The various fields in the sample ID will include but are not limited to the following:

- Site Identifier
- Sample Type
- Sample Location
- Sample Depth
- Sampling Round Number
- Filtered
- Species Identifier
- Sample Group Number

The site identifier must be a three- or four-character field (numeric characters, alpha characters, or a mixture of alpha and numeric characters may be used). A site number is necessary since many facilities/sites have multiple individual sites, SWMUs, operable units, etc. Several examples are presented in Section 5.3 of this SOP.

The sample type must be a two- or three-character alpha field. Suggested codes are provided in Section 5.3 of this SOP.

The sample location must be at least a three-character field but may have up to six-characters (alpha, numeric, or a mixture). The six-characters may be useful in identifying a monitoring well to be sampled or describing a grid location.

The sample depth field is used to note the depth below ground surface (bgs) at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. If the sample depth is equal to or greater than 100, then only the top interval would be represented and the sampling depth would be truncated to

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three-characters. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

A two-digit round number will be used to track the number of aqueous samples taken from a particular aqueous sample location. The first sample collected from a location will be assigned the round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Aqueous samples that are field filtered (dissolved analysis) will be identified with an "-F" in the last field segment. No entry in this segment signifies an unfiltered (total) sample.

The species identifier must be a two-character alpha field. Several suggested codes are provided in Section 5.3 of this SOP.

The three digit sample group number will be used to track the number of biota sample groups (a particular group size may be determined by sample technique, media type, the number of individual caught, weight issues, time, etc.) by species and location. The first sample group of a particular species collected from a given location will be assigned the sample group number 001 and the second sample group of the same species collected from the same location will be assigned the sample group number 002.

### 5.3 Example Sample Field Designations

Examples of each of the fields are as follows:

Site Identifier - Examples of site numbers/designations are as follows:

- A01 - Area of Concern Number 1
- 125 - Solid Waste Management Unit Number 125
- 000 - Base or Facility Wide Sample (e.g., upgradient well)
- BBG - Base Background

The examples cited are only suggestions. Each Project Manager (or designee) must designate appropriate (and consistent) site designations for their individual project.

Sample Type - Examples of sample types are as follows:

- AH - Ash Sample
- AS - Air Sample
- BM - Building Material Sample
- BSB - Biota Sample Full Body
- BSF - Biota Sample Fillet
- CP - Composite Sample
- CS - Chip Sample
- DS - Drum Sample
- DU - Dust Sample
- FP - Free Product
- IDW - Investigation Derived Waste Sample
- LT - Leachate Sample
- MW - Monitoring Well Groundwater Sample
- OF - Outfall Sample
- RW - Residential Well Sample
- SB - Soil Boring Sample
- SD - Sediment Sample
- SC - Scrape Sample



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SG - Soil Gas Sample  
 SL - Sludge Sample  
 SP - Seep Sample  
 SS - Surface Soil Sample  
 ST - Storm Sewer Water Sample  
 SW - Surface Water Sample  
 TP - Test Pit Sample  
 TW - Temporary Well Sample  
 WC - Well Construction Material Sample  
 WP - Wipe Sample  
 WS - Waste/Solid Sample  
 WW - Wastewater Sample

Sample Location - Examples of the location field are as follows:

001 - Monitoring Well 1  
 N32E92 - Grid location 32 North and 92 East  
 D096 - Investigation derived waste drum number 96

Species Identifier - Examples of species identifier are as follows:

BC - Blue Crab  
 GB - Blue Gill  
 CO - Corn  
 SB - Soybean

#### 5.4 Examples of Sample Nomenclature

The first round monitoring well groundwater sample collected from existing monitoring well 001 at SWMU 16 for a filtered sample would be designated as 016MW00101-F.

The second round monitoring well groundwater sample collected from existing monitoring well C20P2 at Site 23 for an unfiltered sample would be designated as 023MWC20P202.

The second surface water sample collected from point 01 at SWMU 130 for an unfiltered sample would be designated as 130SW00102.

A surface soil sample collected from grid location 32 North and 92 East at Site 32 at the 0- to 2-foot interval would be designated as 032SSN32E920002.

A subsurface soil sample from soil boring 03 at SWMU 32 at an interval of 4 to 5 feet bgs would be designated as 032SB0030405.

A sediment sample collected at SWMU 19 from 0 to 6 inches at location 14 would be designated as 019SD0140001. The sample data sheet would reflect the precise depth at which this sample was collected.

During biota sampling for full body analysis the first time a minnow trap was checked at grid location A25 of SWMU 1415 three small blue gills were captured, collected and designated with the sample ID of 1415BSBA25BG001. The second time blue gill were collected at the same location (grid location A25 at SWMU 1415) the sample ID designation given was 1415BSBA25BG002.

Note: No dash (-) or spacing is used between the segments with the exception of the filtered segment. The "F" used for a filtered aqueous sample is preceded by a dash "-F".

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### 5.5 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field QA/QC will be designated using a different coding system. The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN	-F
QC Type	Date	Sequence Number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank  
RB = Rinsate Blank (Equipment Blank)  
FD = Field Duplicate  
AB = Ambient Conditions Blank  
WB = Source Water Blank

The sampling time recorded on the Chain-of-Custody Form, labels, and tags for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the routine sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory). Documentation for all other QC types (TB, RB, AB, and WB) will be recorded on the QC Sample Log sheet (see SOP on Field Documentation).

### 5.6 Examples of Field QA/QC Sample Nomenclature

The first duplicate of the day for a filtered ground water sample collected on June 3, 2000 would be designated as FD06030001-F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003 would be designated as FD11170303.

The first trip blank associated with samples collected on October 12, 2000 would be designated as TB10120001.

The only rinsate blank collected on November 17, 2001 would be designated as RB11170101.

### 6.0 **DEVIATIONS**

Any deviation from this SOP must be addressed in detail in the site specific planning documents.



**TETRA TECH NUS, INC.**

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NON-RADIOLOGICAL SAMPLE HANDLING

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## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

## 2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

## 3.0 GLOSSARY

**Hazardous Material** - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

**Hazardous Waste** - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

**Marking** - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

**n.o.i** - Not otherwise indicated (may be used interchangeably with n.o.s.).

**n.o.s.** - Not otherwise specified.

**Packaging** - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

**Placard** - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

### Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H<sub>2</sub>SO<sub>4</sub>
- Nitric Acid - HNO<sub>3</sub>
- Sodium Hydroxide - NaOH

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#### Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate -  $\text{Na}_2\text{S}_2\text{O}_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

### **4.0 RESPONSIBILITIES**

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

### **5.0 PROCEDURES**

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

#### **5.1 Sample Containers**

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

#### **5.2 Sample Preservation**

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

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changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

### 5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO<sub>3</sub>, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TiNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

### 5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

<b>Acid/Base</b>	<b>Dilution</b>	<b>Concentration</b>	<b>Estimated Amount Required for Preservation</b>
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H <sub>2</sub> SO <sub>4</sub> )	1 part concentrated H <sub>2</sub> SO <sub>4</sub> : 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO <sub>3</sub> )	Undiluted concentrated HNO <sub>3</sub>	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

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- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

### **5.3 Field Filtration**

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

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- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.
- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

#### **5.4      Sample Packaging and Shipping**

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)
- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

##### **5.4.1      Environmental Samples**

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.
- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.
- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.
- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.



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Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

## 6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

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## ATTACHMENT A

### GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration	Container <sup>(1)</sup>	Sample Size	Preservation <sup>(2)</sup>	Holding Time <sup>(2)</sup>
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#### WATER

Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to $\leq 2$	14 days <sup>(9)</sup>
	Extractables SVOCs and pesticide/PCBs)	(Low)	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium)	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO <sub>3</sub> to pH $\leq 2$	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH >12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days

#### SOIL

Organics (GC&GC/MS)	VOC		EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs)	(Low)	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium)	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/inorga nic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	30 days until extraction; 45 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction

#### AIR

Volatile Organics	Low/Medium	Charcoal tube - 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended
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- 1 All glass containers should have Teflon cap liners or septa.
- 2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

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## ATTACHMENT B

### ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
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#### INORGANIC TESTS:

Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid <sup>(5)</sup>	14 days <sup>(6)</sup>
Fluoride	P	None required	28 days
Hardness	P, G	HNO <sub>3</sub> to pH 2; H <sub>2</sub> SO <sub>4</sub> to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

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**ATTACHMENT B**  
**ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,**  
**AND HOLDING TIMES**  
**PAGE TWO**

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
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**INORGANIC TESTS (Cont'd):**

<del>Sulfide</del>	<del>P, G</del>	<del>Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9</del>	<del>7 days</del>
<del>Sulfite</del>	<del>P, G</del>	<del>None required</del>	<del>Analyze immediately</del>
<del>Turbidity</del>	<del>P, G</del>	<del>Cool, 4°C</del>	<del>48 hours</del>

**METALS:<sup>(7)</sup>**

<del>Chromium VI (Hexachrome)</del>	<del>P, G</del>	<del>Cool, 4°C</del>	<del>24 hours</del>
<del>Mercury (Hg)</del>	<del>P, G</del>	<del>HNO<sub>3</sub> to pH 2</del>	<del>28 days</del>
<del>Metals, except Chromium VI and Mercury</del>	<del>P, G</del>	<del>HNO<sub>3</sub> to pH 2</del>	<del>6 months</del>

**ORGANIC TESTS:<sup>(8)</sup>**

<del>Purgeable Halocarbons</del>	<del>G, Teflon-lined septum</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup></del>	<del>14 days</del>
<del>Purgeable Aromatic Hydrocarbons</del>	<del>G, Teflon-lined septum</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup> HCl to pH 2<sup>(9)</sup></del>	<del>14 days</del>
<del>Acrolein and Acrylonitrile</del>	<del>G, Teflon-lined septum</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup> adjust pH to 4-5<sup>(10)</sup></del>	<del>14 days</del>
<del>Phenols<sup>(11)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup></del>	<del>7 days until extraction; 40 days after extraction</del>
<del>Benzidines<sup>(11), (12)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup></del>	<del>7 days until extraction<sup>(13)</sup></del>
<del>Phthalate esters<sup>(11)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C</del>	<del>7 days until extraction; 40 days after extraction</del>
<del>Nitrosamines<sup>(11), (14)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; store in dark; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup></del>	<del>7 days until extraction; 40 days after extraction</del>
<del>PCBs<sup>(11)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C</del>	<del>7 days until extraction; 40 days after extraction</del>
<del>Nitroaromatics &amp; Isophorone<sup>(11)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup>; store in dark</del>	<del>7 days until extraction; 40 days after extraction</del>
<del>Polynuclear Aromatic Hydrocarbons (PAHs)<sup>(11), (14)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup>; store in dark</del>	<del>7 days until extraction; 40 days after extraction</del>
<del>Halocethers<sup>(11)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup></del>	<del>7 days until extraction; 40 days after extraction</del>
<del>Dioxin/Furan (TCDD/TCDF)<sup>(11)</sup></del>	<del>G, Teflon-lined cap</del>	<del>Cool, 4°C; 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub><sup>(5)</sup></del>	<del>7 days until extraction; 40 days after extraction</del>

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**ATTACHMENT B  
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,  
AND HOLDING TIMES  
PAGE THREE**

- (1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
- (2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
- (3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
- (5) Should only be used in the presence of residual chlorine.
- (6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
- (7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
- (8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
- (9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
- (11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
- (12) If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
- (13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- (14) For the analysis of diphenylnitrosamine, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- (15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

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Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>DS</i>		

Subject  
FIELD DOCUMENTATION

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## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Tetra Tech NUS field activities.

## 2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Tetra Tech NUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

## 3.0 GLOSSARY

None

## 4.0 RESPONSIBILITIES

Project Manager (PM) - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

## 5.0 PROCEDURES

### 5.1 Site Logbook

#### 5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded or referenced (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Time and date of H&S training
- Arrival/departure of equipment
- Time and date of equipment calibration
- Start and/or completion of borehole, trench, monitoring well installation, etc.
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day

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that onsite activities take place which involve Tetra Tech NUS or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Tetra Tech NUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the field notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the entry shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

### **5.1.2 Photographs**

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook/notebook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided, since they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend upon the subject matter, type of camera (digital or film), and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Once processed, the slides or photographic prints shall be consecutively numbered and labeled according to the logbook/notebook descriptions. The site photographs and associated negatives and/or digitally saved images to compact disks must be docketed into the project's central file.

### **5.2 Field Notebooks**

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.



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### 5.3 **Field Forms**

All Tetra Tech NUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (<http://intranet.ttnus.com>) under Field Log Sheets. Forms may be altered or revised for project-specific needs contingent upon client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

#### 5.3.1 **Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results**

##### 5.3.1.1 **Sample Log Sheet**

Sample Log Sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

##### 5.3.1.2 **Sample Label**

A typical sample label is illustrated in Attachment B. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source electronically generated in-house, or are supplied from the laboratory subcontractor.

##### 5.3.1.3 **Chain-of-Custody Record Form**

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One carbonless copy of the completed COC form is retained by the field crew, one copy is sent to the Project Manager (or designee), while the original is sent to the laboratory. The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing vials for VOC analysis or the cooler with the air bill attached. The air bill should then state how many coolers are included with that shipment. An example of a Chain-of-Custody Record form is provided as Attachment C. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Tetra Tech NUS Project Manager). The COC form is signed and copied. The laboratory will retain the copy while the original becomes part of the samples' corresponding analytical data package.

##### 5.3.1.4 **Chain-of-Custody Seal**

Attachment D is an example of a custody seal. The Custody seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. The COC seals are signed and dated by the sampler(s) and affixed across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

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#### ~~5.3.1.5      Geochemical Parameters Log Sheets~~

~~Field Analytical Log Sheets are used to record geochemical and/or natural attenuation field test results.~~

### **5.3.2      Hydrogeological and Geotechnical Forms**

#### ~~5.3.2.1      Groundwater Level Measurement Sheet~~

~~A Groundwater Level Measurement Sheet must be filled out for each round of water level measurements made at a site.~~

#### ~~5.3.2.2      Data Sheet for Pumping Test~~

~~During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The Pumping Test Data Sheet facilitates this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be laid out in advance.~~

#### ~~5.3.2.3      Packer Test Report Form~~

~~A Packer Test Report Form must be completed for each well upon which a packer test is conducted.~~

#### ~~5.3.2.4      Boring Log~~

~~During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring, or Boring Log is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a PID or FID), these readings must be entered on the boring log at the appropriate depth. The "Remarks" column can be used to subsequently enter the laboratory sample number, the concentration of key analytical results, or other pertinent information. This feature allows direct comparison of contaminant concentrations with soil characteristics.~~

#### ~~5.3.2.5      Monitoring Well Construction Details Form~~

~~A Monitoring Well Construction Details Form must be completed for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.~~

#### ~~5.3.2.6      Test Pit Log~~

~~When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.~~

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#### ~~5.3.2.7      Miscellaneous Monitoring Well Forms~~

~~Monitoring Well Materials Certificate of Conformance should be used as the project directs to document all materials utilized during each monitoring well installation.~~

~~The Monitoring Well Development Record should be used as the project directs to document all well development activities.~~

#### 5.3.2.8      Miscellaneous Field Forms - QA and Checklists

Container Sample and Inspection Sheet should be used as the project directs each time a container (drum, tank, etc.) is sampled and/or inspected.

QA Sample Log Sheet should be used at the project directs each time a QA sample is collected, such as Rinsate Blank, Source Blank, etc.

Field Task Modification Request (FTMR) will be prepared for all deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Copies of all FTMRs will be maintained with the onsite planning documents and originals will be placed in the final evidence file.

The Field Project Daily Activities Check List and Field Project Pre-Mobilization Checklist should be used during both the planning and field effort to assure that all necessary tasks are planned for and completed. These two forms are not a requirement but a useful tool for most field work.

#### 5.3.3      **Equipment Calibration and Maintenance Form**

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used or in accordance with the manufacturer's recommendations.

#### 5.4      Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

##### 5.4.1      **Daily Activities Report**

To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

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#### 5.4.1.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

#### 5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

#### 5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

#### 5.4.2 **Weekly Status Reports**

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

It should be noted that in addition to summaries described herein, other summary reports may also be contractually required.

All Tetra Tech NUS field forms can be found on the company's intranet site at <http://intranet.ttnus.com> under Field Log Sheets.

#### 6.0 **LISTING OF TETRA TECH NUS FIELD FORMS FOUND ON THE TTNUS INTRANET SITE. HTTP://INTRANET.TTNUS.COM CLICK ON FIELD LOG SHEETS**

Groundwater Sample Log Sheet  
Surface Water Sample Log Sheet  
Soil/Sediment Sample Log Sheet  
Container Sample and Inspection Sheet  
Geochemical Parameters (Natural Attenuation)  
Groundwater Level Measurement Sheet  
Pumping Test Data Sheet  
Packer Test Report Form  
Boring Log  
Monitoring Well Construction Bedrock Flush Mount  
Monitoring Well Construction Bedrock Open Hole  
Monitoring Well Construction Bedrock Stick Up  
Monitoring Well Construction Confining Layer  
Monitoring Well Construction Overburden Flush Mount  
Monitoring Well Construction Overburden Stick Up  
Test Pit Log  
Monitoring Well Materials Certificate of Conformance  
Monitoring Well Development Record

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<p> Daily Activities Record  Field Task Modification Request  Hydraulic Conductivity Test Data Sheet  Low Flow Purge Data Sheet  QA Sample Log Sheet  Equipment Calibration Log  Field Project Daily Activities Checklist  Field Project Pre-Mobilization Checklist </p>		

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**ATTACHMENT A  
TYPICAL SITE LOGBOOK ENTRY**

START TIME: \_\_\_\_\_ DATE: \_\_\_\_\_

SITE LEADER: \_\_\_\_\_

PERSONNEL: \_\_\_\_\_

TINUS

DRILLER

SITE VISITORS

_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE


**ACTIVITIES:**

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well \_\_\_\_ resumes. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well \_\_\_\_\_.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well \_\_\_\_\_.
4. Well \_\_\_\_ drilled. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 2, page \_\_\_\_ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well \_\_\_\_ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit \_\_\_\_\_.
8. Test pit \_\_\_\_\_ dug with cuttings placed in dump truck. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit \_\_\_\_ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

\_\_\_\_\_  
Field Operations Leader

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**ATTACHMENT B**

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> <b>Site:</b> <b>Location:</b>	
<b>Sample No:</b>			<b>Matrix:</b>
<b>Date:</b>	<b>Time:</b>	<b>Preserve:</b>	
<b>Analysis:</b>			
<b>Sampled by:</b>		<b>Laboratory:</b>	



**TETRA TECHNUS, INC.**

## CHAIN OF CUSTODY

NUMBER 3413

PAGE \_\_\_\_ OF \_\_\_\_

[illegible]

# ATTACHMENT C

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ATTACHMENT D

CHAIN-OF-CUSTODY SEAL

<b>Signature</b> <hr/> <b>Date</b> <hr/> <b>CUSTODY SEAL</b>	<b>CUSTODY SEAL</b> <hr/> <b>Date</b> <hr/> <b>Signature</b>
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**TETRA TECH NUS, INC.**

# STANDARD OPERATING PROCEDURES

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Effective Date	09/03	Revision	3
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>[Signature]</i>		

Subject DECONTAMINATION OF FIELD EQUIPMENT

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## 1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The objective/purpose of this SOP is intended to protect site personnel, general public, and the sample integrity through the prevention of cross contamination onto unaffected persons or areas. It is further intended through this procedure to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, monitoring well materials, chemical sampling equipment and field analytical equipment.

## 2.0 SCOPE

This procedure applies to all equipment including drilling equipment, heavy equipment, monitoring well materials, as well as chemical sampling and field analytical equipment decontamination that may be used to provide access/acquire environmental samples. Where technologically and economically feasible, single use sealed disposable equipment will be employed to minimize the potential for cross contamination. This procedure also provides general reference information on the control of contaminated materials.

## 3.0 GLOSSARY

Acid - For decontamination of equipment when sampling for trace levels of inorganics, a 10% solution of nitric acid in deionized water should be used. Due to the leaching ability of nitric acid, it should not be used on stainless steel.

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Decontamination Solution - Is a solution selected/identified within the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

Deionized Water (DI) - Deionized water is tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet CAP and NCCLS specifications for reagent grade, Type I water.

Potable Water - Tap water used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Employs high pressure pumps and nozzle configuration to create a high pressure spray of potable water. High pressure spray is employed to remove solids.

Solvent - The solvent of choice is pesticide-grade Isopropanol. Use of other solvents (methanol, acetone, pesticide-grade hexane, or petroleum ether) may be required for particular projects or for a particular purpose (e.g. for the removal of concentrated waste) and must be justified in the project planning documents. As an example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

Steam Pressure Washing - This method employs a high pressure spray of heated potable water. This method through the application of heat provides for the removal of various organic/inorganic compounds.

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#### 4.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standards Operating Procedures or as otherwise dictated by the approved project plan(s).

Site Health and Safety Officer (SHSO) - The SHSO exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on-site (as part of the equipment inspection), leaving the site, moving between locations are required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Failure to meet these objectives are sufficient to restrict equipment from entering the site/exiting the site/ or moving to a new location on the site until the objectives are successfully completed.

#### 5.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or the isolation of contaminants. In order to accomplish this activity a level of preparation is required. This includes site preparation, equipment selection, and evaluation of the process. Site contaminant types, concentrations, media types, are primary drivers in the selection of the types of decontamination as well as where it will be conducted. For purposes of this SOP discussion will be provided concerning general environmental investigation procedures.

The decontamination processes are typically employed at:

- Temporary Decontamination Pads/Facilities
- Sample Locations
- Centralized Decontamination Pad/Facilities
- Combination of some or all of the above

The following discussion represents recommended site preparation in support of the decontamination process.

##### 5.1 Decontamination Design/Constructions Considerations

##### 5.1.1 Temporary Decontamination Pads

Temporary decontamination pads are constructed at satellite locations in support of temporary work sites. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soils generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations

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- Site Location – The site selected should be within a reasonable distance from the work site but should avoid:
  - Pedestrian/Vehicle thoroughfares
  - Areas where control/custody cannot be maintained
  - Areas where a potential releases may be compounded through access to storm water transport systems, streams or other potentially sensitive areas.
  - Areas potentially contaminated.
- Pad – The pad should be constructed to provide the following characteristics
  - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination.
  - Slope – An adequate slope will be constructed to permit the collection of the water and potentially contaminated soils within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks.
  - Sidewalls – The sidewalls should be a minimum of 6-inches in height to provide adequate containment for wash waters and soils. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls maybe constructed of wood, inflatables, sand bags, etc. to permit containment.
  - Liner – Depending on the types of equipment and the decontamination method the liner should be of sufficient thickness to provide a puncture resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. Achieving the desired thickness maybe achieved through layering lighter constructed materials. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner a light coating of sand maybe applied to provide traction as necessary.
  - Wash/drying Racks – Auger flights, drill/drive rods require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process. A minimum ground clearance of 2-feet is recommended.
  - Maintenance – The work area should be periodically cleared of standing water, soils, and debris. This action will aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross contamination. Hoses should be gathered when not in use to eliminate potential tripping hazards.

#### 5.1.2 Decontamination Activities at Drill Rigs/DPT Units

During subsurface sampling activities including drilling and direct push activities decontamination of drive rods, Macro Core Samplers, split spoons, etc. are typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

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Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected media. Drying racks will be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/re-use.

### 5.1.3 Decontamination Activities at Remote Sample Locations

When sampling at remote locations sampling devices such as trowels, pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition.

## 5.2 Equipment Decontamination Procedures

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

### 5.2.1 Monitoring Well Sampling Equipment

#### 5.2.1.1 Groundwater sampling pumps – This includes pumps inserted into the monitoring well such as Bladder pumps, Whale pumps, Redi-Flo, reusable bailers, etc.

- 1) Evacuate to the extent possible, any purge water within the pump.
- 2) Scrub using soap and water and/or steam clean the outside of the pump and tubing, where applicable.
- 3) Insert the pump and tubing into a clean container of soapy water. Pump a sufficient amount of soapy water through the pump to flush any residual purge water. Once flushed, circulate soapy water through the pump to ensure the internal components are thoroughly flushed.
- 4) Remove the pump and tubing from the container, rinse external components using tap water. Insert the pump and tubing into a clean container of tap water. Pump a sufficient amount of tap water through the pump to evacuate all of the soapy water (until clear).
- 5) Rinse equipment with pesticide grade isopropanol.
- 6) Repeat item #4 using deionized water through the hose to flush out the tap water and solvent residue as applicable.
- 7) Drain residual deionized water to the extent possible, allow components to air dry.
- 8) Wrap pump in aluminum foil or a clear clean plastic bag for storage.

#### 5.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing with the extracted tape and probe with deionized water and wiping the surface of the extracted tape is acceptable. However, periodic full decontamination should be conducted as indicated below.

\* - The solvent should be employed when samples contain oil, grease, PAHs, PCBs, and other hard to remove materials. If these are not of primary concern, the solvent step may be omitted. In addition, do not rinse PE, PVC, and associated tubing with solvents.

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- 1) Wash with soap and water
- 2) Rinse with tap water
- 3) Rinse with deionized water

**Note:** In situations where oil, grease, free product, other hard to remove materials are encountered probes and exposed tapes should be washed in hot soapy water.

#### 5.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) should be cleaned per manufacturer's instructions. This generally includes wiping down the sensor housing and rinsing with tap and deionized water.

Coolers/Shipping Containers employed to ship samples are received from the lab in a variety of conditions from marginal to extremely poor. Coolers should be evaluated prior to use for

- Structural integrity – Coolers missing handles or having breaks within the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples will not be attempted and request a replacement unit.
- Cleanliness – As per protocol only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or associated with noticeable odors it should be decontaminated prior to use.

- 1) Wash with soap and water
- 2) Rinse with tap water
- 3) Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and notify the laboratory to provide a replacement unit.

#### 5.2.2 Down-Hole Drilling Equipment

This includes any portion of the drill rig that is over the borehole including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. This procedure is to be employed prior to initiating the drilling/sampling activity, then between locations.

- 1) Remove all soils to the extent possible using shovels, scrapers, etc. to remove loose soils.
- 2) Through a combination of scrubbing using soap and water and/or steam cleaning remove visible dirt/soils.
- 3) Rinse with tap water.
- 4) Rinse equipment with pesticide grade isopropanol
- 5) To the extent possible allow components to air dry.
- 6) Wrap or cover equipment in clear plastic until it is time to be used.

#### 5.2.3 Soil/Sediment Sampling Equipment

This consists of soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

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- 1) Remove all soils to the extent possible.
- 2) Through a combination of scrubbing using soap and water and/or steam cleaning remove visible dirt/soils.
- 3) Rinse with tap water.
- 4) Rinse equipment with pesticide grade isopropanol
- 5) Rinse with deionized water
- 6) To the extent possible allow components to air dry.
- 7) If the device is to be used immediately, screen with a PID/FID to insure all solvents (if they were used) and trace contaminants have been adequately removed.
- 8) Once these devices have been dried wrap in aluminum foil for storage until it is time to be used.

### **5.3 Contact Waste/Materials**

During the course of field investigations disposable/single use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.) broken sample containers.

With the exception of the broken glass, single use articles should be cleaned (washed and rinsed) of visible materials and disposed of as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned should be containerized for disposal in accordance with applicable federal state and local regulations.

#### **5.3.1 Decontamination Solutions**

All waste decontamination solutions and rinses must be assumed to contain the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. The waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. These containers must be appropriately labeled.

### **5.4 Decontamination Evaluation**

Determining the effectiveness of the decontamination process will be accomplished in the following manner

- Visual Evaluation – A visual evaluation will be conducted to insure the removal of particulate matter. This will be done to insure that the washing/rinsing process is working as intended.
- Instrument Screening – A PID and/or an FID should be used to evaluate the presence of the contaminants or solvents used in the cleaning process. The air intake of the instrument should be passed over the article to be evaluated. A positive detection requires a repeat the decontamination process. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instruments capabilities.



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- Rinsate Blanks – It is recommended that Rinsate samples be collected to
  - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.
  - Single use disposable equipment – The number of samples should represent different types of equipment as well as different Lot Numbers of single use articles.

The collection and the frequency of collection of rinsate samples are as follows:

- Per decontamination method
- Per disposable article/Batch number of disposable articles

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and in an effort to avoid using a contaminated batch of single use articles. It is recommended that a follow up sample be collected during the execution of the project to insure those conditions do not change. Lastly, rinsate samples collection may be driven by types of and/or contaminant levels. Hard to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

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Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>[Signature]</i>		

Subject

BOREHOLE AND SAMPLE LOGGING

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## 1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

## 2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

## 3.0 GLOSSARY

None.

## 4.0 RESPONSIBILITIES

Site Geologist. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

## 5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

### 5.1 Materials Needed

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCl)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

### 5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.



FIGURE 1 (CONTINUED)

## SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)									
COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Size					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size				
FIELD IDENTIFICATION PROCEDURES (Including Field or Larger Than 1 Inches and Rating Practices on Estimated Weights)		GROUP SYMBOL	TYPICAL NAMES		FIELD IDENTIFICATION PROCEDURES (Including Particles Larger Than 1 Inches and Rating Practices on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES
					Identification Procedures (Particles Smaller Than No. 4 Sieve Size)				
					GRAVEL PERCENT (Coarser than No. 40 Sieve)	CLAY MINOR (Coarser than No. 40 Sieve)	FLUIDITY (Coarser than No. 40 Sieve)		
GRAVEL (More than 1/4")	CLEAN GRAVEL (Sand & Gravel)	Use range in grain size and substantial amount of all intermediate sizes.	GW	Well graded gravel, good sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	None to High	Quick to Slow	ML	Inorganic silty and clayey fine sands, not hard, stiff or clayey fine sands with slight plasticity.
	Gravelly sand	Proportionally one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravel, good sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	Medium to High	None to Very Slow	OL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Gravelly sand (High plasticity)	High plasticity (see identification procedures, see HCL)	GM	Medium gravel, poor sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	Medium to High	Slow	CL	Inorganic clays of medium to high plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Gravelly sand (Low plasticity)	Low plasticity (see identification procedures, see LCL)	GC	Clayey gravel, poor sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	High to Very High	None	CH	Inorganic clays of high plasticity, gravelly clays, sandy clays, silty clays, lean clays.
SAND (1/4" to 1/2")	CLEAN SAND (Sand & Gravel)	Use range in grain size and substantial amount of all intermediate sizes.	SW	Well graded sand, good sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	None to High	Quick to Slow	ML	Inorganic silty and clayey fine sands, not hard, stiff or clayey fine sands with slight plasticity.
	Sandy gravel	Proportionally one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sand, good sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	Medium to High	None to Very Slow	OL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Sandy gravel (High plasticity)	High plasticity (see identification procedures, see HCL)	SM	Medium sand, poor sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	Medium to High	Slow	CL	Inorganic clays of medium to high plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Sandy gravel (Low plasticity)	Low plasticity (see identification procedures, see LCL)	SC	Clayey sand, poor sand material, little or no fines.	CLAY AND CLAYE (Less than 1%)	High to Very High	None	CH	Inorganic clays of high plasticity, gravelly clays, sandy clays, silty clays, lean clays.

Boundary classification: Soil consistency characteristics (flow group) is designated by combining group symbols. For example, GW-GC, well graded gravel-sand material with clay sand, also designated as GW-GC.

## DENSITY OF GRANULAR SOILS

PERMEATION	STANDARD PENETRATION RESISTANCE BLOW/FOOT
Very Loose	1-4
Loose	5-9
Medium Dense	10-19
Dense	20-29
Very Dense	30-60

## CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	LABORATORY TEST (UNSATURATED)	STANDARD PENETRATION RESISTANCE BLOW/FOOT	FIELD IDENTIFICATION
Very Loose	Less than 10	1 to 2	Easily penetrated several inches by thumb.
Loose	10 to 20	3 to 4	Easily penetrated several inches by thumb.
Medium Dense	20 to 30	5 to 6	Can be penetrated several inches by thumb.
Dense	30 to 40	7 to 8	Hardly indented by thumb.
Very Dense	40 to 50	9 to 10	Hardly indented by thumb.
Hard	More than 50	Over 10	Indented with difficulty by thumb.

## ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Qualitative Term	Qualitative or Field Rock	Hardness (Rock)	Qualitative Term	Qualitative or Field Rock	Spalling
Soft	Easily damaged	Cracked when pressed with hammer	Very Breakable	(1) (2)	1-4"
10-20 ft	Can be damaged	Breaks (see blow) crumbly edges	Breakable	(3) (4)	1-2"
10-20 ft	Can be damaged	Breaks (see blow) sharp edges	Durable	(5) (6)	1-2"
Hard	Cannot be damaged	Breaks (see blow) (see blow) sharp edges	Indurated	(7) (8)	1-2"

LEGEND:

ROCK SAMPLES - TYPES

1-4" (1-4") Sample

8-12" (8-12") Undisturbed Sample

0 - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

X-100 (Concrete) (Concrete) 1-1/2" (1-1/2")

X-100 (Concrete) (Concrete) 1-1/2" (1-1/2")

2 - Other Core Samples, Specify in Remarks

USGS (USGS)

1-4"

1-2"

1-2"

Hard (Hard) and (Hard)

Soft (Soft) and (Soft)

Soft (Soft) and (Soft)

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### 5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inch $\Phi$ -1/2 inch $\Phi$ )" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

### 5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

### 5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

~~The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.3. Those designations are:~~

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Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

#### 5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent



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**FIGURE 2**

**CONSISTENCY FOR COHESIVE SOILS**

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

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Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

#### 5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

#### 5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

#### 5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

#### 5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

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**FIGURE 3**

**BEDDING THICKNESS CLASSIFICATION**

<b>Thickness (metric)</b>	<b>Thickness (Approximate English Equivalent)</b>	<b>Classification</b>
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

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### 5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone - Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale - A fissile very fine-grained rock. Fractures along bedding planes.
- Limestone - Rock made up predominantly of calcite ( $\text{CaCO}_3$ ). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal - Rock consisting mainly of organic remains.
- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

#### 5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

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**FIGURE 4**

**GRAIN SIZE CLASSIFICATION FOR ROCKS**

<b>Particle Name</b>	<b>Grain Size Diameter</b>
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm

After Wentworth, 1922

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### 5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

### 5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

### 5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).
- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.
- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.
- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the words "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

### 5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2-inch spacing between fractures
- Broken (BR.) - 2-inch to 1-foot spacing between fractures
- Blocky (BL.) - 1- to 3-foot spacing between fractures
- Massive (M.) - 3 to 10-foot spacing between fractures

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The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD  
(After Deere, 1964)

$$RQD \% = r/l \times 100$$

$r$  = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

$l$  = Total length of the coring run.

### 5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

### 5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

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### 5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inches or less), probably continuous layer.
- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."
- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."
- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."
- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.
- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.
- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.
- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.
- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite - A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.



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#### 5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C - Coarse	Lt - Light	Yl - Yellow
Med - Medium	BR - Broken	Or - Orange
F - Fine	BL - Blocky	SS - Sandstone
V - Very	M - Massive	Sh - Shale
Sl - Slight	Br - Brown	LS - Limestone
Occ - Occasional	Bl - Black	Fgr - Fine-grained
Tr - Trace		

#### 5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

##### 5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.
- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.
- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.
- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.
- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.

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FIGURE 5  
COMPLETED BORING LOG (EXAMPLE)



## BORING LOG

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PROJECT NAME:  
PROJECT NUMBER:  
DRILLING COMPANY:  
DRILLING RIG:

NSB - SITE

9594

SOILTEST CO.

CME-55

BORING NUMBER:

SB/MW 1

DATE:

3/8/96

GEOLOGIST:

S.J. CONTI

DRILLER:

R. ROCK

Sample No. and Type or RQD	Depth (FT) or Run No.	Blows / 8" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/FT) or Screened Interval	MATERIAL DESCRIPTION			U S C S *	Remarks	PID/FID Reading (ppm)			
					Soil Density/ Consistency or Rock Hardness	Color	Material Classification			Sample	Sampler BZ	Borehole	Driller BZ
S-1 e 0800	0.0 2.0	7 6 9 10	1.5 2.0		M DENSE	BRN TO BLK	SILTY SAND - SOME ROCK FR. - TR BRICKS (FILL)	SM	MOIST SL. ORG. ODOR FILL TO 4'±	5	0	0	0
S-2 e 0810	4.0 6.0	5 7 9 8	2.9 2.0	4.0	M DENSE	BRN	SILTY SAND - TR FINE GRAVEL	SM	MOIST - W ODOR NAT. MATL. TOOK SAMPLE SB01-0406 FOR ANALYSIS	10	0	-	-
S-3 e 0820	8.0 10.0	6 8 17 16	1.9 2.0	7.0 8.0	DENSE	TAN BRN	FINE TO COARSE SAND TR. F. GRAVEL	SW	WET HIT WATER = 7'±	0	0	0	0
S-4 e 0830	12.0 14.0	7 6 5 8	1.6 2.0	12.0	STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	5	-	-
①	15.0			15.0	M HARD	BRN	SILTSTONE	VER	WEATHERED LO JNTS @ 15.5 WATER STAINS @ 16.5, 17.1, 17.5	0	0	0	0
②	20.0			19'	HARD	GRAY	SANDSTONE - SOME SILTSTONE	BR	DRILL H2O @ 17'± SET TEMP 6' CAS TO 15.5	0	0	0	0
	25.0			15					SET 21"Ø PVC SCREEN 16'-25' SAND 14'-25' PELLETS 12'-14'	0	0	0	0

\* When rock coring, enter rock brokenness.

\*\* Include monitor reading in 8 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: CME-55 RIG, 4 1/4" ID HSA - 9" OD ±

2" SPLIT SPOONS - 140 LB HAMMER - 30" DROP

NX CORE IN BEDROCK RUN (1) = 25 min, RUN (2) = 15 min

Converted to Well:

Yes

No

Well I.D. #:

MW-1

• 1-20Z  
1-80Z

Drilling Area

Background (ppm):

0

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- Enter color of the material in the appropriate column.
- Describe material using the USCS. Limit this column for sample description only. The predominant material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:
  - Trace: 0 - 10 percent
  - Some: 11 - 30 percent
  - And/Or: 31 - 50 percent
- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.
- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.
- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:
  - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.
  - Angularity - describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.
  - Particle shape - flat, elongated, or flat and elongated.
  - Maximum particle size or dimension.
  - Water level observations.
  - Reaction with HCl - none, weak, or strong.
- Additional comments:
  - Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.
  - Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.
  - Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.
  - At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

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- Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.
- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

### 5.5.2 Rock Classification

- Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.
- Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.
- Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.
- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.
- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.
- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.
- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:
  - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.
  - Indicate calcareous zones, description of any cavities or vugs.
  - Indicate any loss or gain of drill water.
  - Indicate drop of drill tools or change in color of drill water.
- Remarks at the bottom of Boring Log shall include:
  - Type and size of core obtained.
  - Depth casing was set.
  - Type of rig used.
- As a final check the boring log shall include the following:
  - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.
  - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

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### 5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely examined to determine general lithology.
- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

### 5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

### 6.0 REFERENCES

Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

### 7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

**APPENDIX C**  
**WORK PLAN FOR SCREENING LEVEL SOIL WASHING TREATABILITY**  
**STUDY**

# **SCREENING LEVEL SOIL WASHING TREATABILITY STUDY WORKPLAN**

Portsmouth Naval Shipyard – Kittery, Maine

Prepared for TtNUS

November 22, 2004

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## **Figures**

Figure 1: Schematic Treatability Study Flow Diagram

## **Tables**

Table 1: Proposed Analytical Program – Soil Washing Treatability Study

## **1.0 Understanding of Project Background and Study Objectives**

ART Engineering, LLC (ART) has been contracted by TtNUS to perform screening level bench tests to obtain a reasonable indication of feasibility of using ex-situ screening and soil washing to remediate contaminated soil at the Operable Unit (OU) 2 within the Portsmouth Naval Shipyard (PNS) in Kittery, Maine. The OU-2 soil is contaminated with two primary chemicals of concern (COCs), including Polycyclic Aromatic Hydrocarbon (PAH) and Lead. The secondary COCs include Antimony, PCB, Aroclor-1254, Dioxin (2,3,7,8- TCDD).

This screening level bench scale study will include a two-tiered testing approach. The objective of the first-tier is to establish the level of primary COC removal achievable through mechanical screening. The objective of the second-tier testing will be to determine the additional level of primary COC removal achievable through secondary treatment. It is assumed and expected that the process of reduction of primary COC concentrations will also address the reduction of secondary COC concentrations by a similar order of magnitude.

ART understands that samples of representative soil will be collected by TtNUS and that ART will provide input in selecting the locations for test pits and borings during development of the sample collection plan.

## **2.0 Bench Scale Testing Methodology**

### **2.1 Justification for Proposed Bench Testing Treatment Methods**

For the bench testing, ART will focus on use of mechanical separation and density separation techniques for cleaning of the soil. Based on ART's experience and considering the site history, it is expected that heavy metals, PCBs, PAH and Dioxins will be primarily associated with organic matter, incinerator slag, metal fragments, ash and the soil fines fraction, which has a large specific surface area for binding of contaminants. Therefore, it is anticipated that a combination of wet screening, fines separation and density separation techniques will be effective in removing contaminants from the soil. For large scale treatment, wet screening and density separation techniques are generally more cost effective as compared to chemical treatment approaches.

## 2.2 Bench Scale Study Tasks and Description

The treatability study includes the following three tasks:

Task 1: Test Samples Characterization

Task 2: Bench-Scale Testing

Task 3: Study Report Preparation

A schematic diagram showing treatability study activities is provided in Figure 1. In the first task, Task 1 “*Test Samples Characterization*”, five composite samples are first characterized and determined representative prior to further bench scale testing. Tasks performed as part of initial test sample characterization are shaded in grey in Figure 1. Task 2 “*Bench Scale Testing*” will be performed on three composite samples which have been determined to be representative by TtNUS based on results of characterization as performed under Task 1.

### 2.2.1 Test Samples Characterization – Task 1

Note: In this task, each of the five test samples will be characterized and processed separately in the treatability study as described in following sections.

#### 2.2.1.1 Task 1A: Pre-Screening (Debris Removal)

Upon receipt of the samples at the treatability study laboratory, the samples (expected sample size approximately 3-gallon) will be homogenized and dry screened at ½” (12.5 mm) to remove debris greater than ½” from the soil. For each test sample, the mass of soil fraction passing through ½” screen and retained on ½” screen will be determined.

#### 2.2.1.2 Task 1B: Characterization of Debris (> ½”)

The soil fraction greater than ½” will be characterized to determine the nature of this fraction. The debris will be washed on a ½” screen and hand sorted into three or more fractions, for example:

- 1) Native rock, cobble stones, gravel

2) Battery fragments, Cinders

3) Other.

Weight of each of sorted fractions will be determined and each fraction will be photographed and described.

#### **2.2.1.3 Task 1C: Particle Size Distribution Analysis**

A particle size distribution analysis on each of the three soil composite samples will be performed using a modified ASTM D 422 method. Screen sizes used will be as followed: 10 mesh (2.0 mm), 18 mesh (1.0 mm), 35 mesh (0.5 mm), 60 mesh (0.25 mm), 120 mesh (0.125 mm), and 200 mesh (0.075 mm). Fractions retained on the screens will be dried and weighed to determine the particle size distribution.

#### **2.2.1.4 Task 1D: Soil Chemical Analysis**

A small subsample of the soil fraction less than 1/2" will be collected for analysis for full list of COCs (Pb, Sb, PAH, PCB and 2,3,7,8- TCDD). Another subsample of the soil fraction less than 1/2" will be dry-screened to pass a 10 mesh sieve and soil fraction passing the 10 mesh sieve will be submitted for chemical analysis for primary COCs (Lead and PAH).

#### **2.2.1.5 Task 1E: Preparation of Interim Soil Characterization Report**

Results of soil chemical analysis will be reported to TtNUS in table-format for determination that the samples are representative of the site. If samples have been determined to be representative by TtNUS, ART will execute the *Bench-Scale Testing* (Task 2).

## **2.2.2 Bench-Scale Testing – Task 2**

Note: In this task, each of three selected test samples determined to be representative for the site, will be characterized and processed separately in the treatability study as described in following sections.

### **2.2.2.1 Task 2A: Chemical Analysis of Debris (> ½")**

The nature of the material present in the debris cannot be predicted at this time. However, depending on the relative quantities of large size native material (rock, gravel, etc.) compared to waste-type material (lead fragments, cinders, etc.), the debris would be sorted and prepared (by crushing for 95 percent passing 10 mesh) for analysis. This data is only expected to provide a broad indication of the COC concentrations present in the waste-type material or to verify whether the large size native materials are relatively free of contamination.

### **2.2.2.2 Task 2B: Mechanical Wet Screening**

ART will process each of the three soil fractions less than ½" through a mechanical wet screening. For each test sample, approximately 1.5 kg of soil fraction less than ½" will be wet screened using 10-mesh, 100-mesh and 200-mesh sieves. A 100-mesh sieve will be used to prevent overloading the fine 200-mesh sieve with coarse sand particles. The soil particles retained on the 100-mesh sieve will be recombined with the soil fraction retained on 200-mesh sieve into a single sand product (-10 mesh + 200 mesh). The wet screening will produce three soil fractions: oversize (-1/2" +10 mesh), sand fraction (-10 mesh +200 mesh), and wash water and fines fraction (-200 mesh). To recover the fines fraction, the wash water and fines will be flocculated and wash water decanted. To determine a mass balance for the screening on dry weight, each of soil fractions generated (oversize, sand and fines) will be weighed and moisture content determined. Samples of oversize, sand and fines fractions will be submitted for chemical analysis for COCs as specified in Table 1.

### **2.2.2.3 Task 2C: Soil Washing Bench Tests – Density Separation**

The overall objective of density separation is to separate light material, porous slag and organic matter, and heavy particles from the sand fraction. Based on site history, it is anticipated that contaminants are associated with the light and heavy particles in the soil. ART will perform two consecutive density separation steps. In the first step, the light material is separated from the sand, and sand after separation will be submitted for chemical analysis. In the second step, the sand after removal lights is separated again to separate heavy (metallic) particles from the sand. The sand after removal of the heavy particles will also be submitted for chemical analysis. The efficiency of separation for each separation step will be determined by analyzing the sand before and after each separation.

ART will first separate the light material from the sand fraction (-10 mesh + 200 mesh) as produced from wet screening (Task 2A). The light fraction will be decanted off, dried and weighed. The sand fraction after lights removal will be weighed and sampled for chemical analysis for primary COCs and moisture content as specified in Table 1. The lights fraction will be submitted for chemical analysis when sufficient material is available to perform chemical analysis.

After light material is removed, the heavy fraction will be separated. A heavy liquid salt solution at density of 2.7 gr/cc will be used to make the separation. In this salt solution, sand particles will “float” to the surface while particulate metal (heavies) will “sink”. This technique provides an indication in the laboratory to the potential effectiveness of density separation for metals removal. In full-scale soil washing processing, mineral spirals or equivalent water based density separation techniques would be used. The heavies will be separated, dried and weighed. The sand fraction after heavy separation will be weighed and sampled for chemical analysis for primary COCs and moisture content as specified in Table 1. The heavies fraction will be submitted for chemical analysis when sufficient material is available to perform chemical analysis.

### **3.0 QA/QC**

The composite samples will be processed in order from low level contamination to increasing levels of contamination. Samples will be labeled and assigned a unique laboratory sample ID.

The laboratory equipment will be decontaminated between different test runs to prevent cross-contamination between samples. Water and soap (Alconox) are used to remove any adhering soil, followed by water rinsing. Containers used for (temporary) sample storage will be clean.

### **4.0 Treatability Study Report – Task 3**

ART will prepare a Treatability Study Report including:

- Description of study;
- Results of Soil Characterization and Bench-Scale Testing;
- Analytical data reports;
- Photos;
- Conclusions;
- Recommendations regarding potential application/benefits of soil separation/soil washing approach for treatment of soils at Portsmouth Naval Shipyard.

At completion of the study ART will prepare a “rough draft” report for comment by TtNUS. After receipt of the first round of comments, ART will issue a “draft” report. After receipt of second round of comments, ART will issue a final report. ART has allowed for one round of comments per submittal.

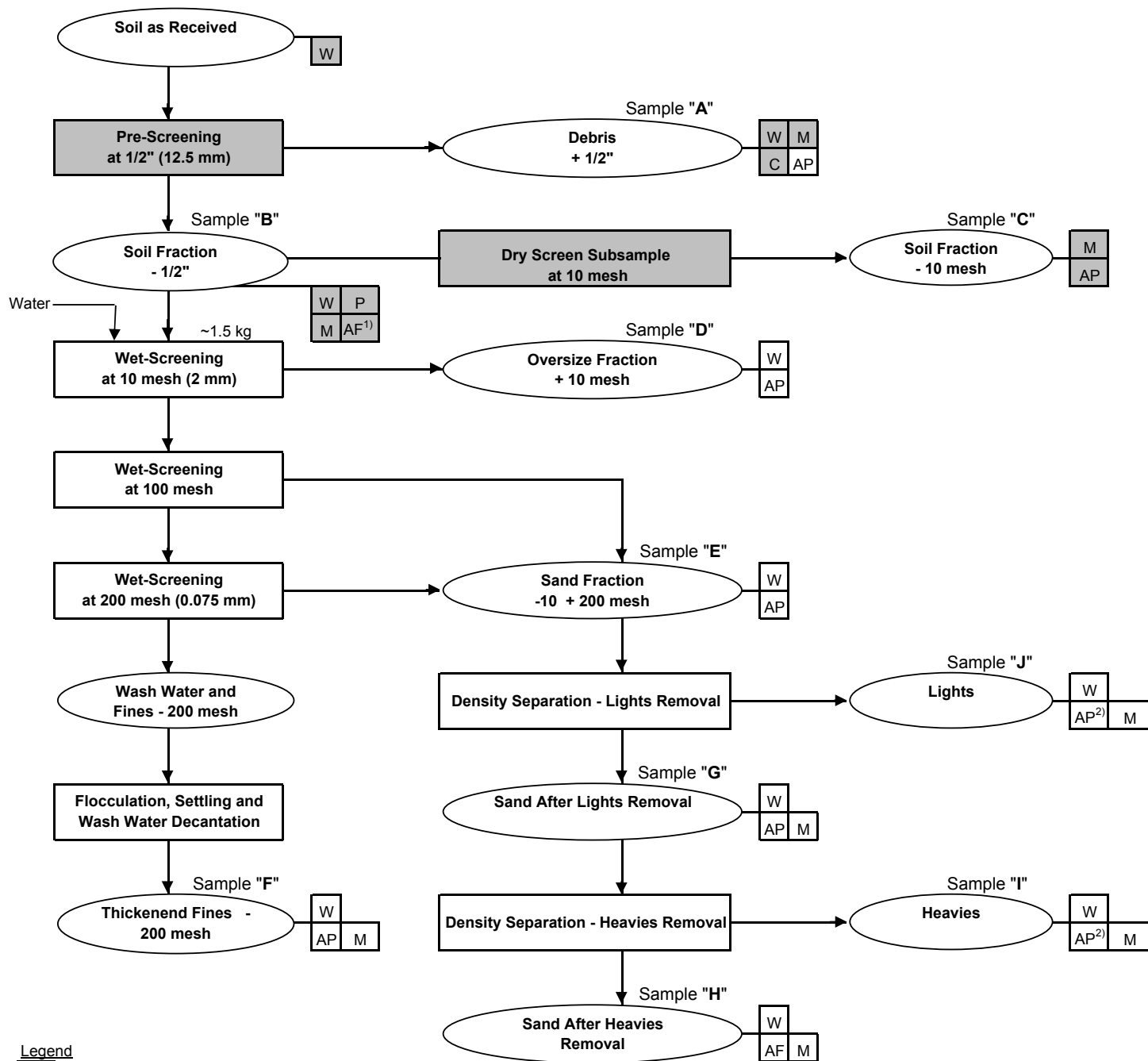
### **5.0 Chemical Analysis**

All chemical analysis will be performed by analytical laboratory under contract to TtNUS. ART will package samples for shipment to analytical laboratory as directed by TtNUS.

# Figures



**Figure 1: Schematic Treatability Study Flow Diagram**  
Portsmouth Naval Shipyard



**Legend**

M	Moisture Content Determined
W	Weight determined
C	Characterization (refer to workplan description)
P	Particle Size Distribution Analysis - by ART
AP	Analysis Primary COCs (Pb, PAH)
AF	Analysis Full List of COCs (Pb, Sb, PAH, PCB (Arochlor) and 2,3,7,8-TCDD)

<sup>1)</sup> Sample crushed to 95% passing 10 mesh screen

<sup>2)</sup> Sample only submitted for chemical analysis when sufficient material available

Testing Performed as part of Task 1: *Test Samples Characterization*

# Tables

**Table 1: Analytical Program - Soil Washing Treatability Study**

Sample	Comments	Sample Designation	No. of Samples	Chemical Analysis					Geotechnical Analysis
				Primary COC's		Secondary COC's			Particle Size
				Pb	PAH	PCB	Sb	2,3,7,8-TCDD	
Initial Soil Characterization									
Soil as received	Soil sample as received will be dry-screened at 1/2"; weight of soil fraction > 1/2" and soil fraction < 1/2" will be determined. Dry-screening at 1/2" will homogenize soil and separate debris > 1/2" from the soil.	--	3 (+2) <sup>1)</sup>						
Soil fraction > 1/2" after dry screening (Debris)	The coarse fraction will be characterized via handsorting and separated fractions will be photographed. ART will coordinate with TtNUS which subsamples will be selected for chemical analysis. Samples for chemical analysis will be crushed to 95 % passing 10 mesh for chemical analysis for primary COCs.	A	3	3	3				
Soil Fraction <1/2" after dry screening	Soil fraction < 1/2" after dry screening will be used for soil characterization and bench scale testing. A subsample of the soil fraction < 1/2" will be crushed to 95% passing through a 10 mesh (2.0 mm) sieve. The soil fraction passing through 10 mesh sieve will submitted for chemical analysis for primary and secondary COCs.	B	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>
Soil Fraction <10 mesh after dry screening	A subsample of the soil fraction < 1/2" will be dry screened to pass through a 10 mesh (2.0 mm) sieve. The soil fraction passing through 10 mesh sieve will submitted for chemical analysis for primary COCs.	C	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>	3 (+2) <sup>1)</sup>				
Soil Fractions after Mechanical Wet Screening									
Oversize (- 1/2" + 10 mesh)	A subsample of soil fraction -1/2" + 10 mesh will be crushed to 95% passing 10 mesh screen for chemical analysis. Crushing make this sample available for chemical analysis using standard analytical methods.	D	3	3	3				
Sand (-10 +200 mesh)		E	3	3	3				
Fines (- 200 mesh)		F	3	3	3				
Soil Fractions after Density Separation									
Sand (-10 + 200 mesh) after slag and organic removal		G	3	3	3				
Sand (-10 + 200 mesh) after heavy particles (metal) removal		H	3	3	3	3	3	3	
Heavies separated from density separation		I	3 <sup>2)</sup>	3 <sup>2)</sup>	3 <sup>2)</sup>				
Lights separated from density separation		J	3 <sup>2)</sup>	3 <sup>2)</sup>	3 <sup>2)</sup>				
Total Analysis				34	34	8	8	8	5

**Note:**

 Analysis highlighted are included in Task: *Test Samples Characterization*
<sup>1)</sup> (+ 2) indicates evaluation/analysis of two additional contingency test pit samples as discussed in Soil Sampling and Treatability Study Work Plan

<sup>2)</sup> Fractions only submitted for chemical analysis when sufficient sample material available.

## **APPENDIX D**

### **RESPONSES TO COMMENTS ON DRAFT WORK PLAN**

**RESPONSES TO USEPA COMMENTS DATED NOVEMBER 4, 2004**  
**DRAFT OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN**  
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **Comment:** Section 2.1.4 Problem Definition, Pg 2-4.

This Section states "it is not known whether soil washing would be feasible for the contaminated soil at Sites 6 and 29". However, the Section does not discuss the criteria that the soil washing will need to meet for the soil remediation. Please add a discussion concerning evaluation criteria.

**Response:** In accordance with the guidance for a "remedy screening" study provided by USEPA in their "Guidance for Conducting Treatability Studies under CERCLA" (October 1992), the *"Remedy Screening studies yield data enabling a qualitative assessment of a technology's potential to meet performance goals"*. The goal for the planned treatability study is to obtain a reasonable indication of the feasibility of using ex-situ screening and soil washing to remediate contaminated soil.

The Navy will provide additional information on the DQOs related to the soil washing portion of the project. Although the USEPA guidance noted above indicates that only qualitative DQOs are needed for a screening level study, the Navy will include some semi-quantitative goals. All of the relevant steps of the DQOs will address the soil washing work, and goals to evaluate the "go/no-go" decision rule will include approximate quantitative criteria. Section 2.3 will be revised to include these additional DQOs.

Also related to DQOs, the Navy agrees with the rationale provided in USEPA guidance wherein a limited quality assurance (QA)/(quality control) QC is sufficient and Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity/Quantitation Limits (PARCCS, discussed in Section 6.3) parameters are more broadly defined for a treatability study at the remedy screening stage. For example, while precision may be calculated by the laboratory for matrix spikes, no acceptance criteria for precision can be established because of the compositional heterogeneity (i.e., the heterogeneous matrices) expected to be present in the samples, although the physical (particle size) heterogeneity will be reduced to the extent possible by ART Engineering, LLC., using size reduction and sieving processes. Consequently, Section 6.3 will be revised as follows:

- Eliminate field duplicates from precision evaluation
- Eliminate field blanks from the accuracy evaluation
- Clarify that the field samples are intended to be biased whereas the samples from the soil washing process are not biased under the sample representativeness evaluation
- Clarify that the current field investigation and the soil washing treatability study will be generating soil samples that cannot be comparable to previous investigations in method of sampling
- Specify that 100 percent of the samples will need to be tested under completeness evaluation
- Clarify that evaluation of sensitivity and quantitation limits are appropriate to the low level concentrations expected in samples from the soil washing process, whereas it is of less concern for the initial site characterization soil samples that are expected to contain higher levels of contaminants.

2. **Comment:** Section 2.2.5 Analytical Tasks, Pg 2-6.

This Section lists benzo(a)pyrene as one of the risk-driving COCs. Table 5-1 (Quantitation Limits for Semivolatile Parameters in Soil) lists for the Parameter benzo(a)pyrene the Target Quantitation Limit as 62 µg/kg and the PQL as 330 µg/kg. This indicates the Target Quantitation Limit cannot be achieved. Since it cannot be achieved, explain how this data can be used to determine if the soil washing is feasible for this contaminant.

**Response:** The target quantitation limit of 0.75 µg/kg for benzo(a)pyrene can be achieved because the analytical instrumentation will be configured to operate in Selective Ion Monitoring (SIM) mode (as opposed to full scan mode) which allows for lower detection limits for the selected Method 8270C target parameters. Table 5-1 shows the achievable laboratory MDLs for all PAHs determined using Method 8270C in SIM mode. As indicated in footnote 2, the laboratory is required to report nondetected results to the adjusted MDLs based on the SIM mode configuration. The PQLs are provided as generic guidelines and represent quantitation limits typically achievable for soil samples analyzed using Method 8270C in full scan mode. The missing units of measure ("µg/kg") will be added to the "Achievable Laboratory MDL" column of the appropriate Section 5 tables.

3. **Comment:** Section 3.2.2.2 Sampling Procedures, Pg 3-4. Section 4-4 Field Quality Control Samples, Pg 4-7. Table 4-1 Field QC Samples.

Field duplicate samples need to be collected to determine the precision of the sampling procedure. Add these instructions and the acceptance criterion to the appropriate Sections of the Work Plan.

**Response:** Field duplicates are not planned for collection because of the less stringent QA/QC that is appropriate for the preliminary stage of the treatability study. The physical heterogeneity of the samples will be reduced to the extent possible by collecting composite samples from each test pit. The targeted sample fractions will be homogenized by ART Engineering, LLC., prior to analysis, thereby further diminishing the effects of heterogeneity.

An additional change to the field QC being proposed is the elimination of equipment rinsate blanks. The volume of the soil composite being collected (3 to 5 gallons) from the large size of the excavated material (several cubic yards) would render cross-contamination caused by any residual smears on the surface of the excavator bucket to be negligible. Also considering that the sample locations are biased towards locations where high levels of chemicals of concern (COCs) are expected to be found, any cross contamination would not be of concern. However, the subcontractor has been specified to use steam decontamination of the excavator bucket before entry/exit from the site, and between test pits as deemed necessary by the TtNUS field operations leader (FOL).

4. **Comment:** Section 5.2 Analytical Method/SOPs and Modifications, Pg 5-1.

The Section states "analytical laboratory SOPs have already been provided under separate cover". Please specify the "separate cover" document.

**Response:** The SOPs were provided with a letter dated July 11, 2002 from Fred Evans to Meghan Cassidy (USEPA RPM), and Iver McLeod (MEDEP RPM), with the subject: "Laboratory

Standard Operating Procedures for the Remedial Investigation of Site 32, Portsmouth Naval Shipyard (PNS), Kittery, Maine." Also please note that a laboratory has been procured (Katahdin Analytical Services, Inc.) and their updated MDLs and IDLs have been provided in Tables 5-1 through 5-4. All of the revisions are minor and if there were any elevations in detection limits, they continue to meet the target quantitation limits. In fact, in several cases, detection limits have decreased.

5. **Comment:** Appendix C Screening Level Soil Washing Treatability Study Work Plan, Section 2.2.2.2 Task 2B: Mechanical Wet Screening, Pg 6.

The Section states "to determine a mass balance for the screening on dry weight, each of the soil fractions generated (oversize, sand and fines) will be weighted and moisture content determined". Explain how the moisture content will be determined.

**Response:** Moisture content will be determined by drying a small sub-sample of each soil fraction in a drying oven at 105 °C.

**RESPONSES TO MEDEP COMMENTS DATED NOVEMBER 9, 2004  
DRAFT OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

**General Comment**

1. **Comment:** There are no DQOs listed for the treatability study, only the soil sampling task. DQOs must be determined for the treatability study in order to develop performance goals. The USEPA's 1992 Final "Guidance for Conducting Treatability Studies under CERCLA"<sup>1</sup> provides a discussion specifically related to treatability studies and DQOs. The Navy should follow the guidance provided in that discussion. See specific comments below.

**Response:** Additional information on the treatability study DQOs will be added to the work plan. Please see the Navy's response to USEPA Comment No. 1 dated November 4, 2004.

2. **Comment:** The report lacks details on the actual purpose of the technology itself. The 1991 EPA Interim Guidance for Soil Washing<sup>2</sup> provides a useful description of the technology. Some of this text should be incorporated into the work plan.

**Response:** Additional description of the technology will be added to Section 2.2 Project Description and Schedule as a new subsection 2.2.3 Soil Washing Treatability Study.

3. **Comment:** We did not find any reference in this document as to whether or not the Navy intends to take PID/FID readings on soil during the excavation process. While no VOCs have been designated at COCs, it is noted on p. 2-3 that occasionally cans of paint and solvents were burned at the Teepee Incinerator. MEDEP recommends that readings be taken and recorded in the field logs.

**Response:** PID/FID readings are not necessary because the available site data indicates that VOCs are not of health and safety concern during test pitting and sampling activities.

4. **Comment:** Please include a References section in the work plan.

**Response:** References will be included.

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1 Guidance for Conducting Treatability Studies under CERCLA, Final, October 1992, EPA/540/R-92/071a, <http://www.epa.gov/superfund/resources/remedy/pdf/540r-92071a-s.pdf>

2 Guide for Conducting Treatability Studies Under CERCLA - Soil Washing. Interim Guidance: September, 1991, <http://www.epa.gov/tio/download/remed/5402-91020a-s.pdf>



## Specific Comments

5. **Comment:** 2.1 Project Planning/Project definition, p. 2-1

“This section documents project planning, provides the site background, and identifies the basis for the investigation (project definition).”

The project definition is never clearly stated in Section 2.0. Is the project the treatability study or the soil sampling to support the treatability study or both? Section 1.1, Objective and Scope, states, “This document provides a discussion...for conducting a screening-level soil washing treatability study...This study will be conducted to obtain a reasonable indication of the feasibility of using ex-situ screening and washing to remediate contaminated soil at OU2.” This latter statement appears to be the project definition. However, Section 2.3 Project Quality Objectives implies that the project is primarily collecting soil samples to support the soil washing study. An overview of the treatability study itself is presented in an appendix as if it was a minor component of the project. Please clarify the project definition.

**Response:** The objective is to conduct the treatability study on OU2 soil; therefore, the work plan discusses both soil sampling and treatability study. Additional information on the treatability study DQOs will be added to the work plan. Please see the Navy’s response to USEPA Comment No. 1 dated November 4, 2004.

6. **Comment:** 2.1.3 OU2 Description and History, Site 6 – DRMO, p. 2-2

“The practices, such as open storage of batteries, which could cause contaminants to be leached or otherwise released...”

It is our understanding that lead contamination at the DRMO is more a result from opening batteries to remove the lead plates, rather than just storage of batteries. This is an important point to note as cracking open batteries would tend to lead to actual particles of lead being released as opposed to lead simply dissolving from the plates as a result of, for example, precipitation. This seems like an important factor to take into account when designing the bench test.

**Response:** Available information indicates that dismantling of batteries occurred in Building 238 and not at the DRMO. The batteries (cells) were stored at the DRMO until off-site disposal/recycling. The Navy agrees that it is not known what form of lead contamination occurs at OU2, however, the most likely possible forms are already adequately accounted for, given the preliminary nature of the testing process. If the lead is present as large size particles, the size-based separation stage of the process should indicate whether it can be removed by screening. If the lead is present as neutrally charged particulates, then the gravity separation step of the process should indicate whether it can be removed by density-based separation. If the lead is present as charged colloids (such as lead compounds associated with the battery acid that could have adsorbed to fine-grained soil), the flocculation step of the process should be able to remove it as sludge. If the lead is present as a compound that is water-soluble (which is unlikely) then, the wastewater from the process should remove it.

7. **Comment:** 2.1.4 Problem Definition, p. 2-4

The Navy has provided a problem statement on 2-5 that states, “Large volume soil samples collected for the treatability study need to reflect the chemical and physical characteristics of the site.” However, on page 2-4 the Navy states, “It is not known whether soil washing would be feasible for the contaminated soil at Sites 6 and 29.” We view this statement as the main problem statement of the project, especially given the statements in Section 1.1 (see Comment 5). The problem definition obviously affects the DQOs so this issue needs to be resolved. Perhaps we need to have two problem statements with two separate corresponding DQOs. See following comment.

**Response:** Additional information on the treatability study DQOs will be added to the work plan. Please see the Navy’s response to USEPA Comment No. 1 dated November 4, 2004.

8. **Comment:** 2.3 Project Quality Objectives and Measurement Performance Criteria, p. 2-7

As the Navy has stated this section details the DQOs for the soil sampling task. However, there should also be a section detailing the DQOs for the soil treatability study itself. As indicated above, the treatability study seems to be the main project whereas the soil sampling is only a project to support the treatability study. DQOs for the treatability study are especially important as currently there are no measures of success for the treatability study. That is, what decisions will be made to determine whether or not soil washing is feasible for OU2? EPA’s 1992 Guidance for Conducting Treatability Studies under CERCLA referenced above indicates that part of the first stage of the three-stage DQO development process, as described in the guidance, is “Identify the treatability study test objectives and performance goals.”

**Response:** Additional information on the treatability study DQOs will be added to the work plan. Please see the Navy’s response to USEPA Comment No. 1 dated November 4, 2004.

9. **Comment:** 2.3.1, Step 4 – Establish spatial and temporal boundaries of investigation, p. 2-9, 2<sup>nd</sup> bullet

“...although attempts should be made to excavate the test pits around the time of low tide in the Piscataqua River.”

If nearby wells are present, a tide-influence time lag should be derived from a sequence of water-levels measurements, and adjustments for groundwater lows (if any) should be observed for scheduling sample collection. Furthermore, excavations may be maximized in depth by picking days in the month when the tidal cycle is most extreme.

**Response:** The depth to low tide is being used as a general guide. Attempts will be made to ensure that excavation does not occur near high tide.

10. **Comment:** 2.3.1, Step 4 – Establish spatial and temporal boundaries of investigation, p. 2-9, 2<sup>nd</sup> bullet

“Optimization of the field investigation includes the collection of contingency samples from two of the five test pits.”

It is noted that the contingency sample locations are further inland, and that these test pits (OU2-TP104 and OU2-TP105) are “located close to the previously detected highest concentrations of lead in subsurface soils” [see p. 3-2]. Therefore, it is surprising that one of these locations was not selected as one of the initial samples to be analyzed. Please explain.

**Response:** The rationale for the test pit locations is provided in Section 3.1.1. TP-104 and TP-105 were considered to be supplemental or replacement sample locations for TP-102, which is in the capped area where the highest concentrations of lead are expected to be present. However, in light of more recent information regarding utility locations, TP-104 has been relocated to the capped area to avoid a utility near Building 298. Therefore, TP-104 is now expected to be closer to higher concentrations of lead than TP-102, and will replace the role of TP-102 as a primary sample location. Consequently, TP-102 will now be a supplemental location. The appropriate revisions to the rationale for TP-102 and TP-104 will be provided in Section 3.1.1 and Table 3-1 will be revised. Figure 3-1 will be revised to show the new location of TP-104 and to delete the soil borings.

11. **Comment:** 2.3.2 Decision Rules, p. 2-10

“...in order to ensure that lead is adequately addressed during the treatability study, it is preferable that elevated levels of lead be present in at least two of the selected composite samples.”

“Preferable” should be changed to “required” or “necessary” (as is indicated in the decision rule process steps).

**Response:** The word "preferable" will be changed to "required".

12. **Comment:** 3.2.1, Test Pits, p. 3-2. 1st paragraph

“The test pits will be a minimum of 10 feet long and 2 feet wide, as necessary, to observe and sample to the maximum depth.”

Depending on actual soil cohesiveness, the pits could cave upon reaching the half-depth goal of 5 feet; and therefore create mixing of soil in the pit for deeper samples. MEDEP suspects this is why the “as necessary” follows the “2 feet wide”. As the Navy must recognize, it will be important to retrieve soil that properly represents each two-foot depth interval.

**Response:** It is not important to very precisely separate the 2-foot intervals of soil, nor is it practical because of side-wall sloughing. The soil sample representing the test pit location will be a composite of each 2-foot section, and therefore, some inevitable intermixing of layers is not of concern.

13. **Comment:** 3.2.2.2 Sampling Procedures, p. 3-4

Samples from the test pits will be sent to an off-site lab for analysis. It seems that x-ray fluorescence, XR-F, would be ideal here. Many samples could be screened very quickly to

ensure that lead requirements, as stated in Section 2.3.2, are met. Has the Navy considered XF-F for this site?

**Response:** The Navy has considered XRF and determined that it is not a practical, cost-effective approach for screening soil samples for this particular project (based on limitations of XRF for organic chemicals and limited number of samples planned). However, as we have in the past, the Navy will continue to consider the application of XRF technologies for future pre-design investigative work during the DQO process.

14. **Comment:** 3.2.2.2, Sampling Procedures, p. 3-4, 2nd & 3rd paragraphs

“Approximately one excavator bucket volume of the material will be removed from each stockpile and mixed to form a stock pile that will represent the various strata from a test pit.”

Please state the procedure that will be used to mix the representative buckets from up to five depth intervals per pit to obtain homogeneity. If only 5 gallons will be submitted for laboratory analyses, this mixing has to be thorough to insure representativeness over the entire depth excavated.

**Response:** Mixing will be conducted manually using shovels and to the extent practicable with the excavator bucket. The TtNUS geologist will ensure that composite is adequately representative of various matrices that can be encountered. This modification has been made based on a recent site visit where physical constraints at the site were noted. The mixing and stockpiling procedure will be modified in the text appropriately. Also, all soil samples will be analyzed at the laboratory without placing any samples on hold at the laboratory before analysis. The text describing the analyses in two stages on page 3-5 will be deleted.

15. **Comment:** Table 5-1, Quantification Limits for Semivolatile Parameters in Soil, p.5-5

MEDEP does not understand why the “Achievable Laboratory MDLs” are so low (1/5 to 1/10 of those given in the Site 34 QAPP), and the Target Quantitation Limits are seemingly quite high. Units of measure are not given for the MDLs, but are assumed to be µg/kg.

**Response:** The “Achievable laboratory MDLs” listed in the Site 34 QAPP are based on SW-846 Method 8270C using analytical instrumentation configured to operate in full scan mode. The operational configuration of the analytical instrument chosen for PAH analysis for the OU2 Treatability Study is the Selective Ion Monitoring (SIM) mode allowing for increased instrument sensitivity and lower detection limits. Also, please note that the units of measure “µg/kg” will be added to the “Achievable Laboratory MDL” columns of Tables 5-1 through 5-4. Also, please note that updated MDLs and IDLs have been obtained from the selected laboratory and revised in these tables.

16. **Comment:** Appendix C, 2.2.2.1, p. 5

“Selected fraction of sorted debris (to be determined with input from TtNUS based on nature of this fraction) will be crushed...”

Please provide some more detail regarding selecting the fraction. What characteristics of the sorted debris would lead one fraction to be chosen over another?

**Response:** The nature of the material present in the debris cannot be predicted at this time. However, depending on the relative quantities of large size native material (rock, gravel, etc.) compared to waste-type material (lead fragments, cinders, etc.), the debris would be sorted and prepared (by crushing for 95 percent passing 10 mesh) for analysis. This data is only expected to provide a broad indication of the COC concentrations present in the waste-type material or to verify whether the large size native materials are relatively free of contamination.

17. Appendix C, 2.2.2.2, p. 6

- a) **Comment:** This section indicates that soil less than ½" will be wet screened using 10 mesh and 200 mesh size opening sieves. Figure 1 indicates that a 100 mesh sieve will also be used. Please clarify.

**Response:** The 100 mesh sieve is used to minimize plugging of the much finer 200 mesh sieve. The fraction retained on the 100 mesh sieve is recombined with fraction retained on the 200 mesh sieve.

- b) **Comment:** "To recover the fines fraction, the wash water and fines will be flocculated and wash water decanted."

Will the flocculation be performed using chemicals? If so, could that process affect the bonding of COCs to the fines therefore resulting in inaccurate concentrations of COCs?

Also, what is the source of the wash water? Could it affect the concentration of COCs on the soil?

**Response:** ART uses standard flocculant products, which do not affect the bonding of COCs and do not affect concentrations of COCs in the fines fraction. Tap water is used as source of wash water. Tap water does not affect concentration of COCs on the soil. Moreover, the mass of contaminated fines (and not the contaminant mass present in the fines) provides the more important data for evaluation of the technology at this stage of the treatability study.

18. **Comment:** Appendix C, 2.2.2.3, p. 6

"Based on site history, it is anticipated that contaminants are associated with the light and heavy particles in the soil."

What historical information leads to this conclusion?

**Response:** This information is based on site history and description as provided in section 2.1.3 in the main workplan document, and ART's experience with soil washing remediation projects. The results of the study should provide indications of whether or not the density-based separation is potentially effective. However, the planned stages of the soil washing process are not impacted by whether this expectation is true or false.

19. **Comment:** Appendix C, QA/QC, p. 7

"The composite samples will be processed in order from low level contamination to increasing levels of contamination."

While this order of processing is desirable, how will the relative level of contamination be known prior to laboratory analysis?

**Response:** Before samples are processed, each of the three test samples are characterized and analyzed as described in section 2.2.1 (Appendix C). Results of this initial analysis will be used to determine order of processing of the samples.

20. **Comment:** Appendix C, Figure 1

According to this figure an analysis of the full list of COCs will be performed only on debris > ½" fraction and on the sand fraction after lights and heavies removal. In Section 2.1 of Appendix C, p. 3, ART Engineering correctly states that, "...it is expected that heavy metals, PCBs, PAH and Dioxins will be primarily associated with organic matter, incinerator slag, metal fragments, ash and the soil fines fraction, which has a large specific surface area for binding of contaminants." Therefore, the Navy should analyze the fines fraction for the full list of COCs as well.

**Response:** The full list of COCs (as indicated by "AF") is planned for the soil fraction (smaller than 1/2-inch screen size, including the fine fraction of soil passing 10 mesh) and not for the debris, which is only being analyzed for the indicator parameters ("AP"), as shown on this figure.

**RESPONSES TO SAPL COMMENTS DATED NOVEMBER 11, 2004  
DRAFT OU2 SOIL SAMPLING AND TREATABILITY STUDY WORK PLAN  
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **Comment: General Comment.** SAPL concurs with the Maine Department of Environmental Protection's (MEDEP's) comments dated November 9, 2004, and the Environmental Protection Agency's (USEPA's) comments dated November 4, 2004, and will not repeat them below.

**Response:** Please see the Navy's responses to USEPA comments dated November 4, 2004 and MEDEP comments dated November 9, 2004.

2. **Comment: Page 2-2, Section 2.1.3 OU2 Description and History.** The description of Site 6 should mention that the rock forming Henderson's Point was blasted in the past, as the Work Plan refers to "blasted rock" in subsequent sections (see page 3-4, for example).

**Response:** Additional text will be added in Section 2.1.3 to mention the blasting of Henderson's Point.

3. **Comment: Page 2-9, Section 2.3.1 Project Quality Objectives, Step 7 Optimize the filed investigation plan.** Please clarify what "adequately representative" means with regard to the first three test pit samples. Does it mean that concentrations are similar to the highest levels previously detected at the sites, or something approaching an 'average' concentration?

**Response:** The representativeness will be assessed by comparing the concentrations to action levels as discussed under Section 2.3.2.

4. **Comment: Page 2-10, Section 2.3.2 Decision Rules.** Please provide the basis for the assumption that lead and benzo(a)pyrene are indicators for the performance of the other inorganic and organic COCs.

**Response:** Lead being an inorganic like antimony, and benzo(a)pyrene, being an organic compound like dioxins and PCBs, are considered to be "performance indicators," because of similarities in properties such as solubility, adsorbability to soil, etc.

5. **Comment: Page 2-11, Section 2.3.2 Decision Rules.** It is not clear if the Action Levels described on page 2-11 apply only to this Treatability Study or if they have been developed for all future actions at OU2. Please clarify.

**Response:** As explained in Section 2.3.2, the action levels are only for this treatability study.

6. **Comment: Page 3-2, Section 3.2.1 Test Pits.** Test pit OU2-TP104 should also be described at the bottom of page 3-2.

**Response:** TP-104 will be described as noted in response to MEDEP Comment No. 10 dated November 9, 2004.

7. **Comment:** Pages 3-4 & 3-5, Section 3.2.2.2 Sampling Procedures. What measures will be implemented to control dust, as well as precipitation infiltration and runoff, during the test pitting?

**Response:** Dust control measures (area wetting) and erosion control measures (haybales, silt curtains, etc.) will be conducted as noted in Section 3.0.

8. **Comment:** Page 3-11, Figure 3-1. What are the proposed soil borings shown on Figure 3-1? If they date from a previous investigation, they should be labeled and a reference should be cited so that the supporting data can be looked up readily.

**Response:** The soil boring locations were erroneously included, and the revised Figure 3-1 will show that they have been deleted.

9. **Comment:** Page 6-1, Section 6.1.2 Field Analysis Data Package Deliverables. When will the HASP, which is mentioned in this section, be provided for review? As noted in SAPL's April 2003 comments on the proposed field demonstration for Site 6, radioactive hazard monitoring should be addressed in the HASP. Engineering controls for dust management and suppression, as well as spill control measures and response should also be covered in the HASP.

**Response:** The HASP was submitted with the work plan to the people listed in the October 1, 2004 cover letter. The HASP addresses engineering controls and spill control measures and responses as necessary for the planned work at OU2.

Consistent with past agreed-upon practice, the Shipyard will continue to conduct on-site radiological overcheck monitoring with a high sensitivity gamma field survey instrument during any "intrusive" work at CERCLA sites (e.g., when sampling substantially below grade, when drilling wells, during test pitting, etc.). A summary of the results from on-site radiological overcheck monitoring during any intrusive work is included in final reports. If any significant result above normal background levels is identified, work will be stopped and the levels will be evaluated. The details of this monitoring will not be included in the Health and Safety Plan because the Shipyard, not the contractors, will be performing the work. Shipyard workers are trained to follow standardized protocols for this type of monitoring.

10. **Comment:** Appendix C. SAPL questions whether the heavy salt solution (Section 2.2.2.3) will adequately separate the clays from the sand, but that should be verified in the lab. Of greater concern is taking the bench scale results to the "real world". Although construction details and procedures are yet to be defined, dust control during soil separation and screening would be a particular concern. Control of the wash water and maintenance of screen openings while processing large quantities of soil are other areas of concern.

**Response:** The Navy recognizes that these and other implementation concerns need to be addressed for the design of the full-scale system. However, unless the technology passes remedy screening, it will not be considered further.